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APGC-TR-67-126

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# Hot and Cold Start Test J79-GE-5C Engine and Sundstrand Starter, Model CPS-13

by

A. R. Goolsby

OCTOBER 1967

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DIRECTORATE OF TECHNICAL SUPPORT  
**AIR PROVING GROUND CENTER**

AIR FORCE SYSTEMS COMMAND • UNITED STATES AIR FORCE

WOLFE AIR FORCE BASE, FLORIDA



HOT AND COLD START TEST J79-GE-5C ENGINE

AND

SUNDSTRAND STARTER, MODEL CPS-13

BY

A. R. GOOLSBY

OCTOBER 1967

This document is a report  
of a test conducted by the  
government. It is to be made  
on the basis of the test  
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## FOREWORD

This report presents the results obtained from the Environmental Starting Test of the J79-GE-5C engine using the Sundstrand Cartridge Pneumatic Starter, Model CPS-13, P/N 702601, S/N 22, Sundstrand Proposal No. 1776A-P1.

The test was conducted during the time period 17 July 1967 and 15 September 1967. The test was conducted under the authority of APGC Project Directive No. 0816V dated 20 July 1967.

The personnel listed below were responsible for the testing on this project.

Project Officer	A. R. Goolsby
Shift Supervisor	D. C. Cain
Project Technicians	C. B. Cardwell C. L. Carter H. M. Carr K. T. Dempsey T. F. Gower V. A. Keyser

## PUBLICATION REVIEW

This report is approved for publication.



R. A. SOUKUP  
Colonel, USAF  
Directorate of Technical Support

#### ABSTRACT

The purpose of this test was to determine the environmental starting capability of the Sundstrand Cartridge/Pneumatic Starter, Sundstrand Proposal No. 1776A-P1 (Model CPS-13), when used on the J79-GE-5C engine. A total of 38 starts were made during this test program, seven at normal ambient temperatures (75°F to 80°F), six at 0°F, nine at -20°F, three at -40°F, two at -65°F, nine at +59°F and two at +135°F. The first 11 runs of the program demonstrated that the J79-GE-5C engine, using a main fuel control, P/N 404045A (unmodified) and the Sundstrand Cartridge/Pneumatic Starter, Model CPS-13, would not make satisfactory starts at -20°F or lower. Runs 12 through 26 demonstrated that the same engine and starter combination equipped with a main fuel control P/N 407070 would not make satisfactory starts at 0°F in the pneumatic mode of starting, but would meet the time to idle requirement at 0°F in the cartridge mode. Runs 27 through 38 demonstrated that the J79-GE-5C engine equipped with the CPS-13 starter and a main fuel control P/N 404045A, with the recommended modifications could make satisfactory starts throughout the temperature range of +135°F through -65°F.

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## INTRODUCTION

High and low temperature starting tests were conducted on a J79-GE-5C engine, S/N G.E.-033585, using a Sundstrand prototype starter, Model CPS-13, P/N 702601, S/N 22. These tests were conducted during the time period of 17 July 1967 and 15 September 1967. The tests were conducted in the Engine Test Cell of the Climatic Laboratory, Eglin Air Force Base, Florida, under the authority of APGC Project Directive No. 0816V, dated 20 July 1967.

The engine was a J79-GE-5B engine built to partially conform to the J79-GE-5C configuration. The major change being the transfer gear box on the front of the engine.

There was no accessory load on the engine during these tests.

The starter, Model CPS-13, used for these tests was designed and built by Sundstrand Aviation at Rockford, Illinois, for use on the B-58 aircraft. The CPS-13 starter has both a cartridge and pneumatic capability for starting. The starter being used on the B-58 at the present time has only a pneumatic capability.

The cartridges used to make the cartridge mode starts were manufactured by the Olin-Mathieson Chemical Corporation. Two different types of cartridges were used, the MXU4/A and MXU4A/A. The air supply for the pneumatic mode starts was supplied by an MA-2 gas turbine compressor operating in the test chamber at the same temperature as the test engine.

The instrumentation for the test was installed in accordance with the instrumentation list shown in paragraph IV of the General Electric Company Test Request, dated 8 May 1967, except that compressor inlet pressures were omitted due to lack of instrumentation probes to measure this parameter. The test request is included as Appendix B of this report.

The observer's log sheets are included as Appendix E of this report. The data shown on these sheets are observed data and may differ slightly from the data shown in graph form, Appendix F, which was taken from the SEL 600 Data System. Appendix C is the fuel analysis of the JP-4 refree fuel (Mil. Spec. MIL-J-5161F Grade 1) used for this test.

The purpose of this test was to determine the environmental starting capability of the Sundstrand Cartridge Pneumatic Starter, Sundstrand Proposal No. 1776A-P1 (Model CPS-13), when used on the J79-GE-5C engine.

#### DESCRIPTION

The test engine used for this test was a basic J79-GE-5B engine equipped with a J79-GE-5C transfer gear box and a Sundstrand Model CPS-13 cartridge/pneumatic starter.

Photographs of the test items are shown in Appendix A, Figures 1 through 5.

#### TEST PROCEDURE

The engine was serviced with MIL-L-7808F oil and MIL-J-5161F Grade I fuel for all runs. The engine was exposed to a 10 hour soak period at the test temperature prior each official test run.

The start procedure used for the official test runs was in accordance with the procedure shown in paragraph III D. 1 and 2 of the General Electric test request dated 8 May 1967, Appendix B. Three deviations were made from the recommended procedure. These deviations were on runs 24 and 26 in the pneumatic mode and run 15 in the cartridge mode. The throttle was pre-set to idle on runs 24 and 26 to determine if a faster start could be made and on run 15 the throttle opening was inadvertently delayed until the engine speed reached 10 percent.

The air supply for the pneumatic mode starts was supplied by a MA-2 gas turbine compressor, Federal Stock No. 1730-917-8014. Two types of start cartridges were used during the test, both were manufactured by the Olin-Mathieson Corporation. The two types of cartridges were: (1) MXU4/A, and (2) MXU4A/A. The observer's log sheets, Appendix E, shows the starts that each was used on.

Starts were made at +135°F, +59°F, -20°F, -40°F, and -65°F. The General Electric test request ask for two cartridge modes and two pneumatic mode starts at each of the test temperatures except +59°F where only one start in each of the modes was requested. After discussing the program with all of the agencies concerned, it was decided that three starts should be made in each start mode at each test temperature except +59°F and only one start in each mode would be satisfactory at +59°F.

The program was modified again, after run 27, following the delays caused by the difficulty experienced with the first two main fuel controls, so that one cartridge start and two pneumatic starts were made at  $-20^{\circ}\text{F}$  and  $-40^{\circ}\text{F}$  and one pneumatic and one cartridge start was made at  $-65^{\circ}\text{F}$  and  $+135^{\circ}\text{F}$ . The program was cut short in order to vacate the test cell to allow a previously scheduled qualification test on the J79-GZ-17 engine to begin. All of the runs from run 27 through 38 were made using the modified main fuel control P/N 404045A, S/N 589794.

### TEST RESULTS AND DISCUSSION

A total of 38 runs were made during this test program. Seven runs were made at normal ambient temperatures,  $+75^{\circ}\text{F}$  to  $+80^{\circ}\text{F}$ . Six runs were made at  $0^{\circ}\text{F}$ , nine at  $-20^{\circ}\text{F}$ , three at  $-40^{\circ}\text{F}$ , two at  $-65^{\circ}\text{F}$ , nine at  $+59^{\circ}\text{F}$  and two at  $+135^{\circ}\text{F}$ .

The first eleven runs of the test were made using main fuel control P/N 404045A prior to the control being modified. The starts using this control in the unmodified condition required from 30 seconds at  $+59^{\circ}\text{F}$  to 137 seconds at  $-20^{\circ}\text{F}$  to reach idle speed. The  $+59^{\circ}\text{F}$  starts were satisfactory but those at  $0^{\circ}\text{F}$  and  $-20^{\circ}\text{F}$  required more than double the allowable time to reach idle. The decision was made to change the main fuel control in an effort to improve the starting time. A new control (a stock item) P/N 407070, S/N 577297 was sent from the Depot at Tinker AFB and installed prior to run 12. Data from one of the slow starts at  $-20^{\circ}\text{F}$  using the original control, P/N 404045A, was plotted and is shown in Figure 6, Appendix F.

Runs 12 through 26 were made using main fuel control P/N 407070. Runs 12 and 13 were check runs to clear the new fuel control and fuel system of air prior to making the test runs. One pneumatic and one cartridge start was made at  $+59^{\circ}\text{F}$  and both starts were within allowable time limits. Data from these starts were plotted and are shown in Figures 7 and 8, Appendix F. Three cartridge and three pneumatic mode starts were made at  $0^{\circ}\text{F}$ . These were made on runs 16 through 21. The pneumatic mode starts did not meet the time requirements in reaching idle but the cartridge mode starts were well within the 45 seconds limit for  $0^{\circ}\text{F}$ . Data from each of these starts were plotted and are shown in Figures 9 through 14, Appendix F.

Run 22 was made to remove the moisture from the engine following a cycling of temperatures within the test chamber.

Runs 23 through 26 were made at -20°F. Three of the starts were pneumatic mode starts and one was a cartridge mode start. These starts were all extremely slow. The cartridge mode start required 77.6 seconds to reach idle speed and the pneumatic mode starts were 85.3, 86 and 82 seconds respectively. Data from one of the pneumatic mode starts, run 23, and the cartridge mode start, run 25, were plotted and are shown in Figure 15 and 16, Appendix F.

The air pressure regulator valve P/N 588811P1, S/N 6475 and the B-58 aircraft configuration piping from the air valve to the starter was removed from the starter air system for the start on run 26. This change was made to determine if the restriction through the air valve and piping was causing the slow starts. The starter air pressure was increased from 40 psig with the valve removed and the time to reach idle speed was reduced from 86 seconds to 82 seconds which was still 35 seconds more than the allowable time to idle.

The original fuel control P/N 404045A was reinstalled prior to run 27. The control had been modified to bring it up to the latest configuration for a control of this type. Four changes were made to accomplish the modification. The changes were as follows: (1) The number of holes in the differential pilot valve bushing was reduced from 4 to 2. This reduction in porting holes reduces the pilot valve gain. (2) A new orifice assembly was inserted into the drilled passage which supplies the main fuel pump discharge pressure signal to the differential pilot valve. The new orifice assembly is of the stand pipe design and contains eight .025 inch diameter holes supplying a .040 inch diameter controlling orifice. The new orifice assembly serves to dampen the pilot valve rendering it less sensitive to pulsations in main fuel pump discharge pressure.

The following changes were made to improve temperature compensation. (1) A close clearance fuel valve was added. (2) A nitrogen filled P3 reference bellows was added.

Runs 24 and 28 were made to check the engine operation and purge the fuel system of air following the main fuel control change. The data from run 28 was plotted and are shown in Figure 17, Appendix F.

Runs 29 through 31 were made at -20°F. Two of these runs were made using the pneumatic mode of starting. Run 29 was made with the air regulator valve and B-58 piping in the starter air line and run 31 was made with this equipment removed. There was a 5 psig difference in the air pressure to the starter and a 10.1 seconds difference in the time to reach idle speed, showing that the air valve and piping were restricting the pressure and flow to the starter. Run 30 was a

cartridge start. Data from these three starts are shown in Figures 18 through 20, Appendix F. Starts on runs 29 and 30 were slower than the 47 seconds allowable time to idle, but run 31 required only 41 seconds to reach idle speed which was well within the allowable time. There was one other difference between the two pneumatic starts at  $-20^{\circ}\text{F}$  that may have contributed to the faster start on run 31. A check was made of the amount of leakage from the P&D valve after run 30 and it was found to be approximately twice the normal leakage. The solenoid valve in the drain line was closed to prevent any leakage on the start for run 31. However, the fuel flows at time of light off showed a difference of only six pounds per hour. Time did not permit a thorough investigation of this condition.

Runs 32 through 34 were made at  $-40^{\circ}\text{F}$ . An oil leak developed on run 32 at the mounting flange of the secondary nozzle pump. Run 33 was made to locate the exact source of the leak. It was decided, due to the limited time available to complete the test, to continue without replacing the pump. The leak was located around the shaft seal of the secondary nozzle pump. Data from runs 32 and 34 were plotted and are shown in Figures 21 and 22, Appendix F.

Runs 35 and 36 were made at  $-65^{\circ}\text{F}$ . The engine failed to fire on the first two attempts on run 35. The third attempt resulted in a good start and a normal acceleration to idle speed. Two possible explanations for the failure to light off on the first two attempts could have been a frost covered fuel nozzle or frost covered ignition plugs, which was cleared by the first two start attempts. Data from the two runs were plotted and are shown in Figures 23 and 24, Appendix F. Both starts were well within the allowable start time at  $-65^{\circ}\text{F}$ .

Runs 37 and 38 were made at  $+135^{\circ}\text{F}$  following soak periods at  $+160^{\circ}\text{F}$ . The pneumatic start, run 37, was slower than the cartridge mode start on run 38 due to the lower starter air pressure at  $+135^{\circ}\text{F}$ . However, both starts were well within the 55 seconds allowable start time at  $+130^{\circ}\text{F}$ . Data from these two starts are shown in Figures 25 and 26, Appendix F.

### CONCLUSIONS

1. The J79-GE-5C engine equipped with the main fuel control P/N 404045A (unmodified) or the main fuel control P/N 407070 and the Sundstrand Starter Model CPS-13 would not meet the cold weather start requirements.
2. The J79-GE-5C engine equipped with a modified main fuel control P/N 404045A and the Sundstrand Starter Model CPS-13 would make satisfactory starts throughout the temperature range of +135°F to -65°F.

### RECOMMENDATION

1. If the Sundstrand Starter Model CPS-13 is to be used on the J79-GE-5C engines, it is recommended that the main fuel control be modified to improve the temperature compensation and to reduce idle rumble.

**APPENDIX A**

**PHOTOGRAPHS OF TEST INSTALLATION**



Fig. 1. J-79-GE-5C engine mounted on test stand

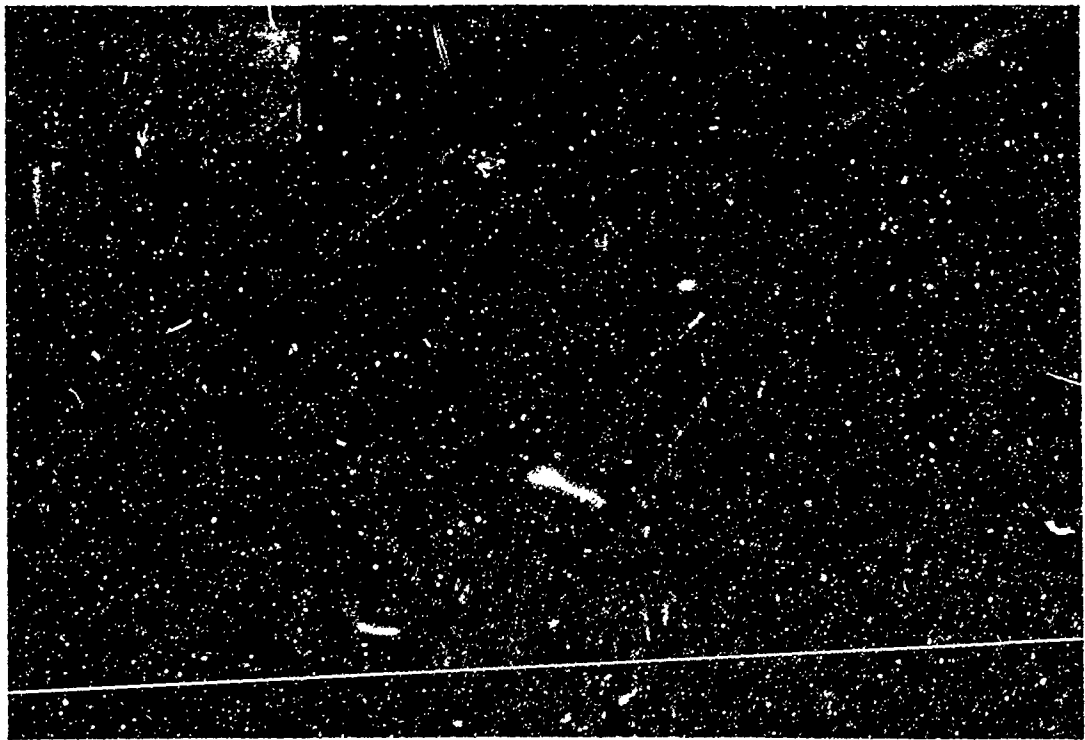


Fig. 2, Lower front view of J-79-GE-5C engine showing the Sundstrand Starter and air valve with air inlet piping from the air valve to starter



Fig. 3, Close up view of Sundstrand Starter mounted on J-79-GE-5C engine

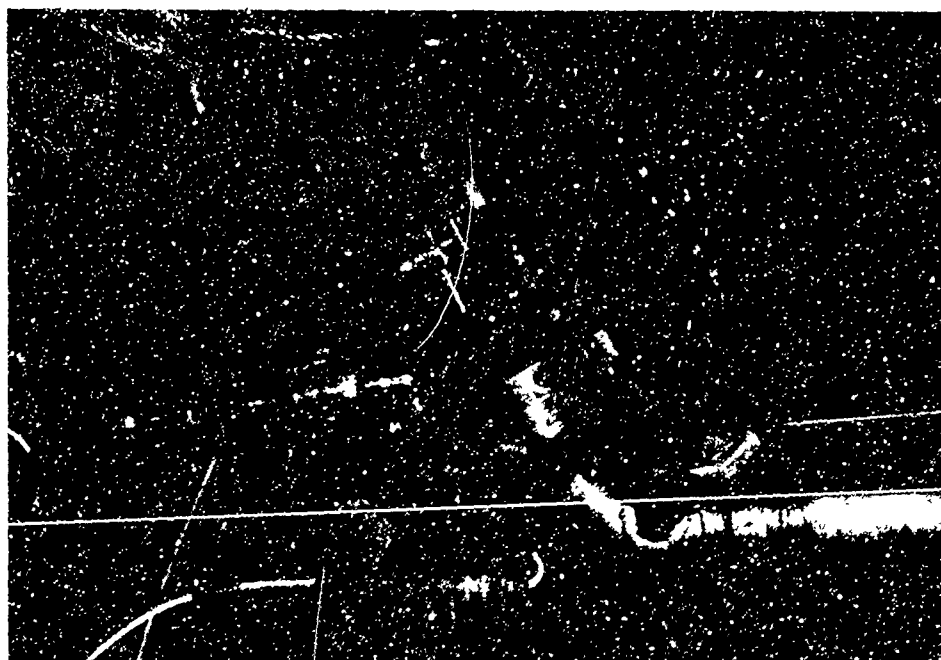


Fig. 4, Close up view of starter air valve

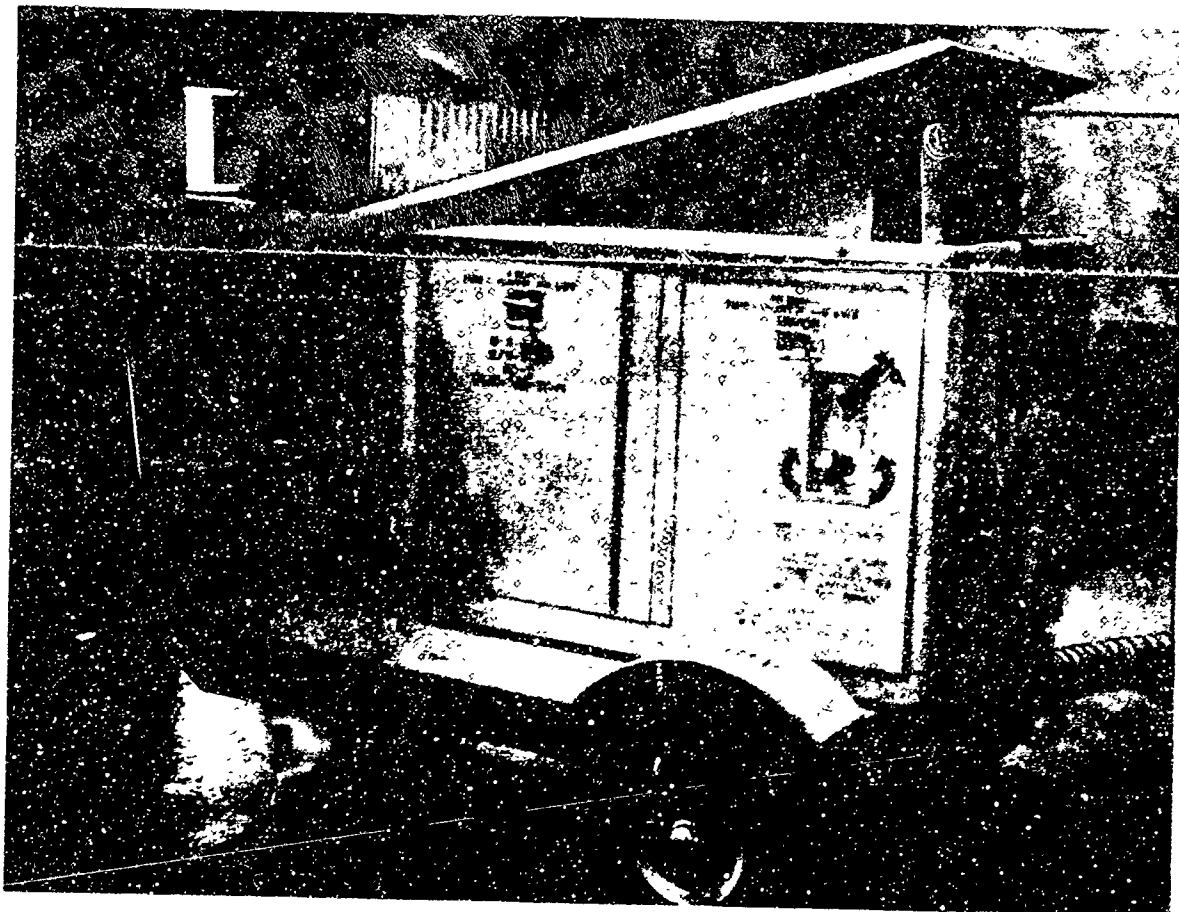


Fig. 5. View of MA-2 gas turbine generator used to supply air to the Sundstrand starter.

**APPENDIX B**

**LETTER OF INSTRUCTIONS AND TEST REQUEST**

OCNEPE

6 June 1967

B58/J79-5C Engine Starter Climatic Tests, Contract AF 33 657-67-C-0553

APGC (Art Goolsby)  
Eglin AFB, Fla. 32542

1. The purpose of these tests is to determine the environmental starting capability of the Sundstrand Cartridge Pneumatic Starter, Sundstrand Proposal No. 1776A-P1 when used on the J79-5C engine. There is no requirement for simulated aircraft accessory loads in either mode of starting during these tests. Basically, these tests will be conducted in two phases:

a. Verify the G.E. Co. base line operation for the test engine, S/N 033585, without accessory loads.

b. Determine the environmental starting characteristics of the engine and the starter capability in both modes of operation.

2. General Electric Company will furnish the engines base line data obtained during cell testing at Evendale, Ohio. They will also supply a complete basic engine minus aircraft QEC components. It is planned to have the engine on site at Eglin by the 15th of June. In addition to the engine SAAMA will furnish a T300J start cart which is scheduled for arrival at Eglin during the latter part of June. SAAMA/SANBTA (Mr. Ed Gray) will also be responsible for supplying the necessary Sundstrand Starters used in these tests. This starter shall use approved Air Force type MXU-4/A series gas generating cartridge in these tests.

3. The attached G.E. Test Request contains the instrumentation requirements for the Eglin facility and those which G.E. Co. will record on their equipment. It also includes test procedures, special instructions and soak times. However, OCAMA Service Engineering (OCNEPE) requires that three starts be performed instead of the two starts which G.E. programmed in Part V of the test procedures. Otherwise the Test Request has been reviewed and is considered acceptable.

4. Your cooperation in this matter is appreciated. Please contact OCNEPE, Mr. W. L. Cramer/2229 if additional information is required or if hardware problems develop.

FOR THE COMMANDER

KENNETH C. KNIGHT  
Chief, Propulsion Branch  
Directorate of Materiel Management

1 Atch  
Test Requests for Environmental Starting Tests

Cy to:  
SAAMA (SANBTA, Mr. Gray)  
AFGLPS (Mr. Huggins)

Test Request for TPS D-57-F,  
D-57-F1 "Environmental Starting  
Tests - J79-5C Engine"

May 8, 1967

E. D. Fagan  
G. E. Representative  
Eglin AFB, Florida

I. PURPOSE OF TEST

Environmental starting tests of the J79-5C with Sundstrand Cartridge Pneumatic Starter (as described in Sundstrand Proposal Nr. 1776A-P1) at Eglin AFB, Florida. Determine the environmental starting capability of the engine without aircraft accessory loads (simulated) utilizing both cartridge and pneumatic mode starter operation. The test will be conducted in three phases as follows:

- a. Established a base line of operation for the test engine (S/N 033585) at Evendale without accessory loads at STP under both operating modes.
- b. Verify the Evendale established base line of operation for the test engine (S/N 033585) at Eglin without accessory loads.
- c. Determine the environmental starting capability of the engine without aircraft accessory loads (simulated) utilizing both cartridge and pneumatic mode of starter operation.

II. PARTS TO BE TESTED

- A. J79-5C engine S/N 033585 with applicable gear boxes.
- B. Cartridge/Pneumatic starter as described in Sundstrand Engineering Proposal No. 1776A-P1, Vol. 1.

III. SPECIAL INSTRUCTIONS

- A. Starter inlet pressures and temperatures supplied to the starter for environmental testing should be consistent with the pneumatic mode data shown in the referenced Sundstrand Proposal.

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### III. SPECIAL INSTRUCTIONS (Cont.)

B. Transient data recordings (or reproduction thereof) are required for all starts in this TPS.

C. Any steady state data taken at idle speed is also required.

D. Starts are to be made utilizing the following procedures for throttle actuation.

- 1) Pneumatic mode: When engine speed reaches 10% advance the throttle to idle position ( $12^\circ$  measured at fuel control input shaft).
- 2) Cartridge mode: Advance the throttle to idle position ( $12^\circ$  measured at fuel control input shaft) and apply ignition an instant before energizing the start switch.

It is requested that a throttle stop be provided to the cell operators input throttle to prevent advancing engine throttle beyond  $12^\circ$  during the starting test at both Evendale and Eglin locations.

E. The fuel used in the tests shall be per Spec. MIL-J-5161F, Grade 1 (Ref. GE Spec. E-714E, dated 9/22/66) and oil will be per Spec. MIL-L-7808F, (Ref. GE Spec. E-714-E dated 8/22/66).

F. An engine brake shall be used if necessary during soak for environmental tests to prevent rotation while soaking.

G. It is desired to use shop air for pneumatic starts at Evendale and a rated 1A-1A cart for pneumatic starts at Eglin.

H. Dynamic fuel manifold pressure measurements should be very close coupled and for cell readouts for idle readings, a solenoid valve should be installed in the cell readout line at the engine tap off point. This solenoid valve will be in a closed position for all environmental baseline and Eglin starts to prevent abnormal manifold fill times.

I. Fuel temperature, a specific gravity sample and a barometer reading are to be taken just prior to each start for Evendale and Eglin tests.

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### III. SPECIAL INSTRUCTIONS (Cont.)

J. A tap off line with a three-way Solenoid valve utilized at the tap off point should be installed on the drain line from the P&D valve. This provision is desired so that any P&D valve leakage may be drawn off into a container during start, but will allow any steady state leakage and shutdown drainage to be relieved through the normal path.

K. Record the manufacturer and date of manufacture of each cartridge used on each run. This should be available on the cartridge container.

L. The engine will be equipped with an oil tank so the lube system will be self contained.

### IV. INSTRUMENTATION

GE, Evendale will plan to supply 1 eight channel Sanborn recorder and operator. Parameters are as follows:

<u>Parameter</u>	<u>Sanborn Scales</u>	<u>Start Mode</u>	
		<u>Pneu.</u>	<u>Cart.</u>
1. Engine Speed	0 to 1000 rpm	X	X
	0 to 2500 rpm	X	X
	0 to 5500 rpm	<u>X</u>	X
2. Fuel Flow	0 to 1000 lb/hr	X	X
	0 to 3000 lb/hr	<u>X</u>	X
3. Compressor Discharge Wall Static Press.	0 to 10 psig	X	X
	0 to 40 psig	<u>X</u>	X
4. Exhaust Gas Temp.	-65 to 300°F	X	X
	-65 to 1435°F	<u>X</u>	X
5. Starter Inlet Pressure Total	0 to 50 psig	<u>X</u>	NA
6. Starter Inlet Temp.	-65 to 440°F	<u>X</u>	NA
7. Fuel Manifold Press.	0 to 200 psig	<u>X</u>	X

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IV. INSTRUMENTATION (Cont.)

<u>Parameter</u>	<u>Sanborn Scales</u>	<u>Start Mode</u>	
		<u>Pneu.</u>	<u>Cart.</u>
8. Cart. Breech Press.	0 to 2000 psig	NA	X
9. #4 Fuel Nozzle Temp.	-65° to 2400°F	X	X
10. #9 Fuel Nozzle Temp.	-65° to 2400°F	NA	X

The following data is to be recorded on Eglin's Digital System:

<u>Parameter</u>	<u>Range</u>
Engine Inlet Temperature (T2)	-70 to 170°F
Starter Inlet Valve Actuation	(0 to 1)
#2 Bearing Temperature	-70 to 500°F
Lube Pump Discharge Pressure	0 to 1000 psia
Scavenge Pump Discharge Pressure	0 to 1000 psia
Spark Rate #4 Can	--
Fuel Nozzle Thermocouple #4	0 to 1000°F
Engine Speed	(0 to 5500 rpm)
Fuel Flow, Main	0 to 3000 lb/hr
Fuel Flow, Verification	0 to 3000 lb/hr
Compressor Discharge Wall Static Pressure	0 to 40 psig
Exhaust Gas Temperature (EGT 5.1)	(-65 to 1435°F)
Fuel Manifold Pressure	0 to 200 psig
Exhaust Nozzle Area (A8)	Min to Max
Stator Angle (B1)	Min to Max

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IV. INSTRUMENTATION (Cont.)

<u>Parameter</u>	<u>Range</u>
Throttle Angle ( )	Min to Max
Fuel Nozzle Thermocouple #9	0 to 1000°F
Starter Air Pressure (Inlet)	0 to 50 psig
Starter Air Temperature (Inlet)	-70 to 450°F
Starter Breech Pressure	0 to 2000 psia
Engine Inlet Pressure, Static (PS2)	0 - 25 psia
Engine Inlet Pressure, Total (Pt2)	0 - 25 psia

V. TEST PROCEDURES - EGLIN

Phase I (GE, Evendale)

Phase I consists of testing at GE, Evendale to establish engine performance, mechanical integrity and base line data.

Phase II (Eglin AFB)

Phase II consists of Eglin AFB checkout and Evendale Base Line Verification.

Run 1 - Eglin

Start engine under same mode and with same engine and starter conditions as in Run 1 and 2 - FPD. Operate engine at idle for 10 minutes to stabilize and take 3 data readings a 1 to 2 minute intervals, then shutdown engine. Engineering from Evendale will supply information regarding engine and starter conditions at Evendale.

Run 2 - Eglin

After satisfactory comparison of idle data with Evendale base line, make a start again with engine and starter conditions as in runs 1 and 2 - FPD. Again compare Eglin data with Evendale base line.

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V. TEST PROCEDURES - Eglin (Cont.)

Run 3 - Eglin

Make a start with conditions as in Runs 3 and 4 - FPD.  
Compare with Evendale, base line.

After satisfactory baseline comparison and instrumentation verification, proceed with Phase III environmental tests.

Phase III, Part I (Eglin AFB, Environmental Tests)

Perform the following runs (Starts):

Run No.	Engine Inlet Air °F Temp	Starting Modes Pneu. Cart.		ACC Loads	Soak & Run Requirements
4-Eglin	+135	X	-	None	X
5-Eglin	+135	X	-	None	X
6-Eglin	+135	-	X	None	X
7-Eglin	+135	-	X	None	X
8-Eglin	+52	X	-	None	XX
9-Eglin	+59	-	X	None	XX
10-Eglin	-20	X	-	None	XX
11-Eglin	-20	X	-	None	XX
12-Eglin	-20	-	X	None	XX
13-Eglin	-20	-	X	None	XX
14-Eglin	-40	X	-	None	XX
15-Eglin	-40	X	-	None	XX
16-Eglin	-40	-	X	None	XX

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V. TEST PROCEDURES - Eglin (Cont.)

Run No.	Engine Inlet Air	Starting Modes		ACC Loads	Soak & Run Requirements
	<u>°F Temp</u>	<u>Pneu.</u>	<u>Cart.</u>		
17-Eglin	-40	-	X	None	XX
18-Eglin	-65	X	-	None	XXX
19-Eglin	-65	X	-	None	XXX
20-Eglin	-65	-	X	None	XXX
21-Eglin	=65	-	X	None	XXX

See Item VI

Phase III, Part I (Eglin AFB, Environmental Tests)

It is expected that ambient starts below -40°F in cartridge mode could possibly result in hang-ups or deceleration after starter cut out; depending upon cartridge burn time and engine light off. In such cases, as A Go and No-Go existing for two tries at a particular temperature, a third run will be programmed in cartridge mode for that condition. Any hangups in pneumatic mode operation will also be repeated.

VI. SOAK TIME

Requirements

\* The engine and its oil system to be subjected to a soaking period of 4 hours beginning from the time engine inlet air temperature stabilizes at +160°F. The oil, air and fuel supplied to the engine during the start to be at +135°F.

\*\* The engine and its oil system to be subjected to a soaking period of six (6) hours beginning from the time engine inlet air temperature stabilizes at the specified inlet air temperature, or until the engine #2 bearing reaches the same temperature as the specified inlet air temperature, (+5°F) which ever represents the longer times. The oil, air and fuel supplied to the engine during the start to be the same as the specified inlet air temperature.

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VI. SOAK TIME (Cont.)

\*\*\* The engine and its oil system to be subjected to a soaking period of six (6) hours beginning from the time engine inlet air temperature stabilizes at -63°F or until the engine #2 bearing reaches a temperature of -60 to -65°F which ever represents the longer time. The oil, air and fuel supplied to the engine during the start to be at -65°F.

John C. Smith  
J79/J93 QEF Evaluation  
Building 500, K-54, Ext. 4894

**APPENDIX C**

**FUEL ANALYSIS**

FUELS TEST REPORT				DATE 20 July 1967		
SUBMITTED BY Mr. A.R. Goolsby/PGVWT		TEST LABORATORY AND LOCATION PGVWP, Eglin AFB, Fla.		ORIGIN OR CONTRACTOR		
LABORATORY TEST NUMBER						
DATE RECEIVED IN LAB		20 Jul 67				
SPECIFICATION NUMBER		T5161-E				
GRADE NUMBER		JP-4, Grade 1				
CONTRACT NUMBER						
QUANTITY REPRESENTED (GALS)						
TYPE CONTAINER AND NUMBER		Gal. Can				
SAMPLE NUMBER						
REMARKS (PERTAINING TO SAMPLE AS RECEIVED)		Referee Fuel				
<del>MOISTURE</del> Sp. Gr.		.758				
GRAVITY *A.P.I.		55.18				
WSIM						
APPEARANCE		Clear				
COLOR		Water White				
ODOR						
WATER REACTION		No. 1				
FREEZING POINT *F		Below -67				
CORROSION		No. 1				
EXISTENT GUM, MG/100 ML		.4				
POTENTIAL GUM, MG/100 ML						
OXIDATION PPT. MG/100 ML						
DOCTOR TEST						
MERCAPTAN SULFUR, % WT.						
TOTAL SULFUR, % WT.						
VAPOR PRESSURE, P.S.I. @ 100* F		2.85				
ANILINE POINT *F		133				
ANILINE GRAVITY CONSTANT OR B.T.U.		67319				
SMOKE POINT MM (OR SMOKE VOL INDEX)						
AROMATICS, %						
OLEFINS, %						
TETRAETHYLLEAD ML/GAL						
FLASH POINT, *F						
KNOCK RATING		LEAN	RICH	LEAN	RICH	
TOTAL SOLIDS, MG/GAL		.52				
FIBROUS MATERIAL PER/QT						
VISIBLE FREE WATER ML/GAL						
NONCOMBUSTIBLE SOLIDS MG/GAL						
TOTAL WATER, PPM BY VOL BY KARL FISCHER						
THERMAL STABILITY, TUBE DEPOSIT CODE NO.						
THERMAL STABILITY, PRESSURE DIFF. (IN. HG.)						
MIL-I-27686 ICIN-3 INHIBITOR, % BY VOL						
DISTILLATION		180 *F	152	147 *F	152	
REMARKS (PERTAINING TO USABILITY AND DISPOSITION OF MATERIAL)		10%	211	221	14	
		20%	229	275	45	
		40%	264	290	52	
		50%	280	370	90	
		90%	363	400	95	
		10%	50%	470		
		E PT.	467	REC 98.6	E PT.	REC
		RES %	1.0	LOSS .4	RES %	LOSS
		APPROVED BY: (NAME AND SIGNATURE OF LAB SUPV)		NEVIN A. HARRIS		

AFTO FORM 68  
SEP 65

SUPERSEDES SEP 63 EDITION WHICH WILL BE USED.

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**APPENDIX D**

**TABULATED START DATA**

**RUN SUMMARY**  
**J79-GE-5C ENGINE S/N 093-585**

Date	Run No.	Test Temp. °F	Time To Fire Sec.	Time To Max RPT Upr Sec.	Fuel Flow At Fire PPH	Peak Fuel Flow PPH	Ave. Starter Air Press PSIG	Ave. Starter Breech Press PSIG	Cartridge Burn Time Sec.	Remarks
7/17	1	480	17.7	--	1132	732	1695	29	--	RPM imperative for this run
7/18	2	480	14.7	89	905	666	1887	32	--	Starter air supplied by MA-1A
7/19	3	459	9.4	40.0	853	726	1948	58	--	Starter air supplied by MA-2 on all subsequent runs unless noted otherwise
7/19	4	459	10.7	36.3	1002	769	1959	50	--	
7/20	5	459	9.9	35.8	1094	768	1936	50	--	
7/20	6	459	9.4	32.7	963	727	2036	--	16.7	This was the first cartridge start
7/21	7	-20	12.9	--	599	623	751	58	--	Start discontinued at 2355 RPM after 2 min. 59 sec. cranking
7/21	7	-20	10.5	137	636	640	2011	58	--	2nd Attempt on run no. 7
7/24	8	459	11.4	--	932	716	802	46	--	Engine failed to reach idle speed
7/24	8	459	10.1	--	960	676	803	46	--	Engine failed to reach idle speed
7/25	8	459	9.3	51	1000	700	1819	52	--	3rd attempt on run 8
7/25	9	459	10.1	97	1000	720	1820	51	--	Check run
7/25	10	459	9.1	30	1060	740	1950	52	--	Check run
7/26	11	0°F	10.5	100.5	624	633	1849	32	--	Check run at 0°F
8/15	12	470	17.6	73.9	910	709	1819	36	--	Check run to check engine after control change. Starter air valve and B58 air inlet to starter piping installed prior to this start.

RUN SUMMARY  
J79-GE-5C Engine S/N 033-585

Date Run 1967	Run No.	Time		Test To Temp. Of	Time Idle Sec.	Fuel Flow At Fire PPH	Peak Fuel Flow PPH	Ave.		Cartridge Burn Time Sec.	Remarks
		Fire Sec.	Max. KGT Of					Starter Air Press. PSIG	Starter Breach Press. PSIG		
8/16	13	485	14.8	42	1110	685	1940	36.5	--	--	Check run
8/16	14	459	14.5	40	1114	755	1950	37	--	--	Good start
8/17	15	459	11.2	30	985	821	1986	--	825	17	Good start
8/18	16	0	15.6	48.8	831	757	1915	40	--	--	Good start
8/21	17	0	17.6	53.2	915	729	1873	39	--	--	Good start
8/22	18	0	14.7	50.8	811	756	1879	40	--	--	Good start
8/23	19	0	14.04	40.7	892	730	1904	--	820	17	Good start
8/24	20	0	10.1	35.4	792	747	1869	--	800	18	Good start
8/25	21	0	10.5	37.4	736	733	1893	--	810	18	Good start
8/28	22	475	15.5	51	1140	685	1830	36	--	--	Check run to remove moisture from engine
8/29	23	-20	15.4	45.36	617	752	1933	37	--	--	Slow start
8/30	24	-20	14.3	46	795	707	1854	40	--	--	Slow start
8/31	25	-20	12.1	77.6	657	719	2040	--	770	19	Slow start
9/1	26	-20	11.2	82	630	712	1936	52	--	--	Slow start, The starter air valve was removed for this start

**RUN SUMMARY**  
**J79-03-5C Engine S/N 033-585**

Date Run 1967 No.	Test Temp. OF	Time To Fire Sec.	Time To Idle Sec.	Fuel Flow Max OF	Fuel Flow At Fire PPH	Peak Fuel Flow PPH	Ave.		Cartridge Burn Time Sec.	Remarks
							Starter Air Press. PSIG	Breach Press. PSIG		
9/8 27	-40	15	49	1090	650	1905	37.5	--	--	Check run after installing modified fuel control
9/8 28	-40	12.8	42	1150	630	2000	38	--	--	2nd check run to completely clear the fuel control of air
9/9 29	-20	11.9	51.1	666	657	1953	46	--	--	Good start except a little slower than desired
9/10 30	-20	12	52	718	653	1973	--	795	--	There was a delay in breach press. indication due to inst. error.
9/11 31	-20	10.5	41	712	666	1940	51	--	--	This start was made with the air reg. valve and B-58 piping removed from the starter air line
9/12 32	-40	12.8	52.9	748	635	1979	--	760	20	Good start except a little slower than desired.
9/12 33	-40	11	34	640	630	1968	57.5	--	--	This run to check for oil leak. the leak did not show up on this run
9/12 34	-40	13.5	52	655	641	1975	46	--	--	Good start : The B-58 air regulator valve and piping to the starter were re-installed prior to this run.
9/13 35	-65	13	47	716	633	1979	46	--	--	This was a 3rd attempt start. the engine failed to fire on the first two attempts
9/13 36	-65	13.4	45	874	610	2100	--	750	19	Good start
9/14 37	-135	13.9	52	1182	556	1917	32.5	--	--	Good start
9/15 38	-135	10.1	37.7	1130	589	2103	--	860	14.2	Good start

W

**APPENDIX E**

**OBSERVER'S LOG SHEETS**

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 17 July 1967		TEST TEMPERATURE (°F) +80 Outside Air	FUEL MIL-J-5161F Grade 1	RUN NO. 1
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 1429	TIME ENGINE STARTED 1427
TEST OPERATOR Demossy	BAR. TEMPERATURE	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :02	
HRS COLD SOAK PRIOR TO START	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :02	
TIME TO FIRE MM 19 SEC	TIME TO REACH 5000 RPM MM 105 SEC	MAX TPY DURING START 1130 <sup>°F</sup>	TEST OBSERVER Cardwell	
RUN DOWN TIME 2 MN 23 SEC	PURPOSE OF RUN To check engine after installation.			BAR. READING
TIME	RPM	REMARKS		
1427	0	<p>NOTE: This engine was changed from a -5B configuration to a -5C. The transfer gear box has been changed.</p> <p>A MA-1A will be used to furnish air to the starter.</p> <p>Sundstrand starter, Model CPS-13, P/N 702601, S/N 22 installed.</p> <p>The engine fired at 1120 rpm with 690 pph fuel flow. The peak fuel flow was 950 pph. The starter air pressure was 31 psig and starter was cut out at 92½ seconds.</p> <p>The engine speed indication was not reading correctly and observed speeds could not be recorded.</p> <p>The engine was rumbling at idle.</p>		
1429:15	5000	Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL <b>J79-GE-5C</b>		ENGINE SERIAL NO. <b>GE-033585</b>		<b>1</b>
DATE <b>18 July 1967</b>		TEST TEMPERATURE (°F) <b>+80°F Outside Air</b>	FUEL <b>MIL-J-5161F Grade 1</b>	RUN NO. <b>2</b>
FUEL SYSTEM USED <b>Normal</b>	LUBE OIL GRADE <b>MIL-L-7808F</b>	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED <b>1347</b>	TIME ENGINE STARTED <b>1339</b>
TEST OPERATOR <b>Dampsey</b>	MAN. TEMPERATURE <b>+80°F</b>	RELATIVE HUMIDITY %	TOTAL TIME OF RUN <b>:08</b>	
HRS COLD SOAK PRIOR TO START	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE <b>:10</b>	
TIME TO FIRE MIN <b>13.5</b> SEC	TIME TO REACH 5000 RPM MIN <b>87</b> SEC	MAX TPT DURING START <b>970 °F</b>	TEST OBSERVER <b>Cardwell</b>	
RUN DOWN TIME <b>2 MIN 34.4</b> SEC	PURPOSE OF RUN <b>To check engine after installation.</b>		BAR. READING <b>30.01" Hgs</b>	
TIME	RPM	REMARKS		
1339	0	The engine fired at 1040 rpm with 660 pph fuel flow. The peak fuel flow was 1680 pph. The starter air pressure averaged 30 psig with a peak starter inlet air temp. of 338°F. The starter was cut out at 3000 rpm and 62 seconds.		
1341:30	5150	Set speed to 5900 rpm and back to idle to exercise control.		
1342	5200	Enter cell to inspect engine. Engine was OK.		
1343	5200	Set throttle to 5900 rpm and back to idle to exercise fuel control.		
1347	5200	Shut down.		
NOTE: There was very little rumble on this run.				

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL <b>J79-GE-5C</b>		ENGINE SERIAL NO. <b>GE-033585</b>		<b>1</b>
DATE <b>19 July 1967</b>		TEST TEMPERATURE (°F) <b>+59</b>	FUEL <b>MIL-J-5161F Grade 1</b>	RUN NO. <b>3</b>
FUEL SYSTEM USED <b>Normal</b>	LUBE OIL GRADE <b>MIL-L-7808F</b>	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STARTED <b>1129</b>	
TEST OPERATOR <b>Dempsey</b>	BAR. TEMPERATURE <b>+81°F</b>	RELATIVE HUMIDITY %	TIME ENGINE STOPPED <b>1132</b>	
HRS COLD SOAK PRIOR TO START <b>15½</b>	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME OF RUN <b>:03</b>	
TIME TO FIRE MIN <b>7</b> SEC	TIME TO REACH- <b>5500 RPM</b> MIN <b>40</b> SEC	MAX TPT DURING START <b>925 °F</b>	TOTAL TIME ON ENGINE <b>:13</b>	
RUN DOWN TIME <b>2</b> MIN <b>14</b> SEC	PURPOSE OF RUN <b>To obtain data at +59°F.</b>		TEST OBSERVER <b>Cardwell</b>	
TIME	RPM	REMARKS		
<b>1129</b>	<b>0</b>	<p>NOTE: Cartridge lot No. OL-6-463, batch No. B95E-47 will be used on this start.</p> <p>The engine fired at 1060 rpm with 700 pph fuel flow. The peak fuel flow was 2350 pph. The peak starter breech pressure was 850 psig with an average of 840 psig. The burn time was 16½ seconds.</p>		
<b>1131:30</b>	<b>5150</b>	<p>The engine was shut down while checking idle dead band.</p>		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL <b>J79-GE-5C</b>		ENGINE SERIAL NO. <b>GE-033585</b>		<b>1</b>
DATE <b>19 July 1967</b>		TEST TEMPERATURE (°F) <b>+59</b>	FUEL <b>MIL-J-5161F Grade 1</b>	RUN NO. <b>4</b>
FUEL SYSTEM USED <b>Normal</b>	LUBE OIL GRADE <b>MIL-L-7808F</b>	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED <b>1510</b>	
TEST OPERATOR <b>Dempsey</b>	BAR. TEMPERATURE <b>+82°F</b>	RELATIVE HUMIDITY %	TOTAL TIME OF RUN <b>:02</b>	
HRS COLD SOAK PRIOR TO START <b>3½</b>	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE <b>:15</b>	
TIME TO FIRE MIN <b>9.5</b> SEC	TIME TO REACH <b>5150 RPM</b> MIN <b>36</b> SEC	MAX TPT DURING START <b>1000</b> °	TEST OBSERVER <b>Cardwell</b>	
RUN DOWN TIME <b>2</b> MIN <b>15</b> SEC	PURPOSE OF RUN <b>To obtain starting data at +59°F.</b>		BAR. READING <b>30.03" Hga</b>	
TIME	RPM	REMARKS		
		<p>NOTE: This start will be made using the MA-2 to supply air to the starter.</p> <p>Prior to this start fuel nozzles, P/N GE867C 492P3 were removed from No. 4 and No. 9 combustion cans.</p> <p>Fuel nozzles, P/N 867C 492P3FA, were installed.</p>		
<b>1508</b>	<b>0</b>	The engine fired at 1250 rpm with 755 pph fuel flow. The peak fuel flow was 1975 pph. The starter air inlet pressure averaged 50 psig with a peak pressure of 51 psig and peak temp. of 360°F. The starter was cut out at 3000 rpm and 25 seconds.		
<b>1510</b>	<b>5180</b>	Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 20 July 1967		TEST TEMPERATURE (°F) +59	FUEL MIL-J-5161F Grade 1	RUN NO. 5
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STARTED 0810	
TEST OPERATOR Dampsey	BAR. TEMPERATURE +77°F	RELATIVE HUMIDITY %	TIME ENGINE STOPPED 0811	
HRS COLD SOAK PRIOR TO START 17	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME OF RUN :01	
TIME TO FIRE MIN 9.8 SEC	TIME TO REACH 5000RPM MIN 36 SEC	MAX TPT DURING START 1035 °F	TOTAL TIME ON ENGINE :16	
RUN DOWN TIME 2 MIN 6 SEC	PURPOSE OF RUN To obtain starting data at +59°F.		TEST OBSERVER Cardwell	
BAR. READING 30.11" Hga				
TIME	RPM	REMARKS		
0810	0	The engine fired at 1250 rpm with 770 pph fuel flow. The peak fuel flow was 1970 pph. The starter air pressure was 50 to 51½ psig with a peak temp. of 362°F. The starter was cut out at 25 seconds and 3000 rpm.		
0811	5200	Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 20 July 1967		TEST TEMPERATURE (°F) +59°F	FUEL MIL-J-5161F Grade 1	RUN NO. 6
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 1510	TIME ENGINE STARTED 1507
TEST OPERATOR Dempsey	BAR. TEMPERATURE +78°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :03	
HRS COLD SOAK PRIOR TO START 6 hours 57 minutes	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :19	
TIME TO FIRE MIN 8.5 SEC	TIME TO REACH 5100 RPM MIN 33 SEC	MAX TPT DURING START 960 °F	TEST OBSERVER Cardwell	
RUN DOWN TIME 2 MIN 22 SEC	PURPOSE OF RUN To obtain starting data at +59°F.			BAR. READING 30.15" Hga
TIME	RPM	REMARKS		
1507	0	<p>NOTE: Cartridge lot No. CL-6-463, batch No. B95D-9 will be used on this test.</p> <p>The engine fired at 1100 rpm with 770 pph fuel flow. The peak fuel flow was 2250 pph. The starter breach pressure peaked at 910 psig and averaged 860 psig. The burn time was 16.7 seconds.</p> <p>Shut down. The engine was shut down while checking idle dead band. The dead band appears to be between 8 and 14 degrees indicated on throttle position indicator.</p> <p>NOTE: A motoring check was made after the run and the following data recorded.</p> <p>Air pressure 52 psig with a peak temp. on starter inlet air of 383°F. The following speeds and time was noted:</p> <p>1000 rpm at 7 seconds, 1500 rpm at 16 seconds and 1580 rpm at 22 seconds which was the maximum speed obtained.</p>		
1508:50				

OBSERVER'S LOG				PAGE NO.
J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 21 July 1967		TEST TEMPERATURE (°F) -20		RUN NO. 7
FUEL SYSTEM USED Normal		FUEL MIL-J-5101F Grade 1		TIME ENGINE STARTED 0910
TEST OPERATOR Dempsey		LUBE OIL GRADE MIL-L-7808F		TIME ENGINE STOPPED 0913
HRS COLD SOAK PRIOR TO START See Log		NO. LBS. OF OIL USED DURING RUN		TOTAL TIME OF RUN :03
TIME TO FIRE MIN 9.8 SEC		BAR. TEMPERATURE +74°F		TOTAL TIME ON ENGINE :22
TIME TO REACH 5000 RPM 2 MIN 16 SEC		RELATIVE HUMIDITY %		TEST OBSERVER Cardwell
RUN DOWN TIME 1 MIN 36 SEC		MAX TTY DURING START 635 °F		BAR. READING 30.16" Hga
PURPOSE OF RUN To obtain starting data at -20°F.				
TIME	RPM	REMARKS		
0802	0	<p>NOTE: The MA-2 will be used to supply air to the starter.</p> <p>Soak time 13 hours before this attempt.</p> <p>The engine fired at 1320 rpm with 640 gph fuel flow. The starter air pressure was 60 psig with a peak starter air temp. of 326°F. The engine speed began to slow down at approx. 2100 rpm. At elapsed time of 1 minute and 30 seconds the speed was 2280 rpm and max. speed reached was 2340 rpm. The engine was cranked with starter assist for 2 minutes and 25 seconds. The starter was cut out and speed dropped very little. The throttle was returned to cut off and start aborted at 2 minutes and 30 seconds.</p> <p>The fuel flow at speed hang-up was 725 gph. The peak E.G.T. was 655°F and E.C.T. at speed hang-up was 580°F. The throttle was advanced during the speed hang-up with no noticeable effect.</p> <p>2nd Attempt:</p>		
0910	0	The engine fired at 1280 rpm with 640 gph fuel flow. The peak fuel flow was 2000 gph. The starter air pressure was 59 psig with a peak inlet temp. of 331°F. The starter was cut out at 1 minute and 53 seconds and 3000 rpm.		
0913	5100	Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 24 July 1967		TEST TEMPERATURE (°F) +59	FUEL MIL-J-5161F Grade 1	RUN NO. 8
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STARTED 1305	
TEST OPERATOR Dempsey	BAR. TEMPERATURE 81	RELATIVE HUMIDITY %	TIME ENGINE STOPPED 1307	
HRS COLD SOAK PRIOR TO START	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME OF RUN :02	
TIME TO FIRE MIN 9.3 SEC	TIME TO REACH 5150 RPM MIN 51 SEC	MAX TBT DURING START 1000 °F	TOTAL TIME ON ENGINE :24	
RUN DOWN TIME 2 MIN 17 SEC	PURPOSE OF RUN Check run.	TEST OBSERVER Carter	BAR. READING 30.04" Hga	
TIME	RPM	REMARKS		
0914	0	<p>NOTE: This run is being made to determine the accuracy of the fuel flow. The C.D.P. signal line to the main fuel control has been disconnected for this run.</p> <p>Starter on: The engine fired at 10.5 seconds at 1300 rpm. The fuel flow at fire was 700 pph. The engine was cranked for 1 minute and 45 seconds. The speed the engine reached was 2800 rpm. The starter was cut out at 1 minute and 45 seconds with the throttle left open. The speed increased to 2840 rpm. The air pressure to the starter was 48 psig. The fuel pressure (Boost) read 18 psig. The peak fuel flow was 790 pph. E.G.T. 940°F.</p> <p>NOTE: Prior to the second attempt the main fuel control C.D.P. reference drain line was disconnected and the C.D.P. signal line remained disconnected.</p>		
0946	0	<p>Second attempt: The engine fired at 9.4 seconds at 1250 rpm. The fuel flow at fire was 660 pph. The engine was cranked for 1 minute and 45 seconds. The speed the engine reached was 2890 rpm. The starter was cut out at 1 minute and 45 seconds. The throttle was left open for 2 minutes. The starter air pressure was 47 psig. The starter air temp. was 440°F. The fuel boost pressure was 18 psig. The peak fuel flow was 790 pph. Maximum E.G.T. was 940°F.</p> <p>25 July 1967</p> <p>Prior to this attempt the C.D.P. signal line to the main fuel control has been re-connected.</p>		
1305	0	<p>Third attempt: The engine fired with 700 pph fuel flow. The peak fuel flow was 1819 pph. The starter was cut out in 33 seconds at 3000. The starter air pressure was 52 psig. The peak temp. was 367°F.</p>		
1307	5150	Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-G2-5C		ENGINE SERIAL NO. GE-033585		1
DATE 25 July 1967		TEST TEMPERATURE (°F) +59	FUEL MIL-J-5161F Grade 1	RUN NO. 9
FUEL SYSTEM USED Normal		LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 1340
TEST OPERATOR Dempsey		BAR. TEMPERATURE +84°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :01
HRS COLD SOAK PRIOR TO START		FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :25
TIME TO FIRE    MIN 9    SEC		TIME TO REACH 5150 RPM    MIN 32    SEC	MAX TPT DURING START 1030 °F	TEST OBSERVER Carter
RUN DOWN TIME 2 MIN 27 SEC		PURPOSE OF RUN To check engine without engine fuel boost.		DAR. READING 29.98" Hga
TIME	RPM	REMARKS		
1339	0	NOTE: The test cell boost pump will not be used for this run. This was done to determine if the cell boost was having any effect on engine starts.		
1340	5150	The engine fired with 740 pph fuel flow. The peak fuel flow was 1220 pph. The starter air pressure was 52 psig. The peak starter air temperature was 365°F. The starter was cut out in 26 seconds at 3000 rpm.		
		Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL		ENGINE SERIAL NO.		R/JN NO.
J79-GE-5C		GE-033585		10
DATE	TEST TEMPERATURE (°F)	FUEL	TIME ENGINE STARTED	
25 July 1967	+59	MIL-J-5161F Grade 1	1350	
FUEL SYSTEM USED	LUBE OIL GRADE	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED	
Normal	MIL-L-7808F		1351	
TEST OPERATOR	BAR. TEMPERATURE	RELATIVE HUMIDITY %	TOTAL TIME OF RUN	
Dempsey	+84°F		:01	
HRS COLD SOAK PRIOR TO START	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE	
			:26	
TIME TO FIRE	TIME TO REACH	MAX TPT DURING START	TEST OBSERVER	
MIN 9.1 SEC	5150 RPM MIN 34 SEC	1060 °F	Carter	
RUN DOWN TIME	PURPOSE OF RUN		BAR. READING	
2 MIN 23 SEC	To obtain starting data.		29.98" Hga	
TIME	RPM	REMARKS		
1350	0	<p>NOTE: This start will be made using the engine test cell fuel boost pump.</p> <p>The engine fired with 740 pph fuel flow. The peak fuel flow was 1950 pph. The starter air pressure was 52 psig. The air temperature was 364°F. The starter was cut out in 25 seconds at 3000 rpm.</p> <p>NOTE: There was no apparent difference between starts with the boost pump on or off.</p>		
1351	5150	Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 26 July 1967		TEST TEMPERATURE (°F) 0°F	FUEL MIL-J-5161F Grade 1	RUN NO. 11
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STARTED 0809	
TEST OPERATOR Dampsey	AIR TEMPERATURE 38°F	RELATIVE HUMIDITY %	TIME ENGINE STOPPED 0812	
HRS COLD SOAK PRIOR TO START 16	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME OF RUN :03	
TIME TO FIRE MIN 10 SEC	TIME TO REACH 5000 RPM MIN 100 SEC	MAX YPT DURING START 630°	TOTAL TIME ON ENGINE :29	
RUN DOWN TIME 1 MIN 63 1/2 SEC	PURPOSE OF RUN To obtain starting data at 0°F.		TEST OBSERVER Cardwell	
BAR. READING 29.99" Hga				
TIME	RPM	REMARKS		
0809	0	<p>NOTE: The main fuel control C.D.P. reference drain line which was disconnected prior to the second attempt on run No. 8 is still disconnected.</p> <p>The engine fired at 1280 rpm with 640 pph fuel flow. The peak fuel flow was 1620 pph. The starter air pressure averaged 57 psig and starter was cut out at 75 seconds and 3000 rpm. The engine speed reached 2350 rpm at 37 seconds and 2500 rpm at 53 seconds. Speed increase was real slow on up to 3000 rpm.</p>		
0811:30	5150	<p>Shut down.</p> <p>NOTE: The reference drain fuel was approximately 3 1/2 pints.</p>		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 12
DATE 15 August 1967	TEST TEMPERATURE (°F) Outside Air +70°F	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0937	
FUEL SYSTEM USED Moxtral	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0942	
TEST OPERATOR Gowar	BAR. TEMPERATURE +78°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :05	
HRS COLO SOAK PRIOR TO START	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :34	
TIME TO FIRE MIN 15.5 SEC	TIME TO REACH 5100RPM MIN 72 SEC	MAX TPT DURING START 915 °F	TEST OBSERVER Cardwell	
RUN DOWN TIME 2 MIN 38 SEC	PURPOSE OF RUN To check engine operation after control change.		BAR. READING 30.02" Hg	
TIME	RPM	REMARKS		
		<p>NOTE: Main fuel control P/N 404045A, S/N 589794 removed.</p> <p>Fuel control P/N 407070, S/N 577297 installed.</p> <p>An air valve P/N 588811P1, S/N 6475 was installed before the starter using the B58 configuration. This installation was made at the request of Sundstrand Company to protect the starter from pressures above 60 psig from the MA-2 start cart expected at cold temperatures.</p>		
0949	0	The engine was given a wet pre-start. The peak fuel flow was 740 pph leveling off at 650 pph fuel flow. The starter air pressure was 37 psig with a peak air temperature before the valve of 405°F. The maximum cranking speed was 1400 rpm.		
0937	0	The engine fired at 1250 rpm with 685 pph fuel flow. The peak fuel flow was 1820 pph. The starter air pressure was 37 psig with a peak temperature of 394°F. The throttle was opened at 10 seconds and 1000 rpm. The started switch was manually cut at 3000 rpm and 55 seconds.		
0940	5150	Exercised throttle to obtain 6200 rpm and back to idle through several cycles.		
0942	5150	Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL <b>J79-GE-5C</b>		ENGINE SERIAL NO. <b>GE-033585</b>		<b>1</b>
DATE <b>15 August 1967</b>		TEST TEMPERATURE (°F) <b>Outside Air +85°F</b>		RUN NO. <b>13</b>
FUEL SYSTEM USED <b>Normal</b>		FUEL <b>MIL-J-5161F Grade 1</b>		TIME ENGINE STARTED <b>1046</b>
TEST OPERATOR <b>Gower</b>		LUBE OIL GRADE <b>MIL-L-7808F</b>		TIME ENGINE STOPPED <b>1048</b>
HRS COLD SOAK PRIOR TO START		BAR. TEMPERATURE		TOTAL TIME OF RUN <b>:02</b>
TIME TO FIRE MIN SEC <b>14.8</b>		MAX TPT DURING START <b>1110°</b>		TOTAL TIME ON ENGINE <b>:36</b>
RUN DOWN TIME MIN SEC		PURPOSE OF RUN <b>To obtain starting data.</b>		TEST OBSERVER <b>Cardwell</b>
TIME		RPM		BAR. READING <b>30.03" Hga</b>
1046		0		REMARKS  The engine fired at 1220 <sup>8</sup> rpm with 685 pph fuel flow. The peak fuel flow was 1940 pph. The starter air pressure was 36½ pgaig and starter was cut out manually at 3000 rpm and 33 seconds. The peak air temperature before the air valve was 375°F.  Shut down.
1048		5180		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-C33585		RUN NO. 14
DATE 16 August 1967	TEST TEMPERATURE (°F) +59	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0822	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0824	
TEST OPERATOR Gowex	AIR TEMPERATURE +76°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :02	
HRS COLD SOAK PRIOR TO START 14½	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :38	
TIME TO FIRE MIN 13.5 SEC	TIME TO REACH 5100 RPM MIN 41 SEC	MAX TPT DURING START 1115°	TEST OBSERVER Cardwell	
RUN DOWN TIME 2 MIN 20 SEC	PURPOSE OF RUN To obtain starting data at +59°F.		BAR. READING 30.06:Hga	
TIME	RPM	REMARKS		
0822	0	The engine fired at 1180 rpm with 750 pph fuel flow. The peak fuel flow was 1940 pph. The starter air pressure was 38 psig with a peak air temperature before the air valve of 350°F. The starter switch was manually cut at 3000 rpm and 32 seconds.		
0824	5140	Shut down.		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 15
DATE 17 August 1967	TEST TEMPERATURE (°F) +59	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0810	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0812	
TEST OPERATOR Gower	BAR. TEMPERATURE +79°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :02	
HWC COLD SOAK PRIOR TO START 23½	PY LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :40	
TIME TO FIRE    MIN 10.5 SEC	TIME TO REACH 5100 RPM    MIN 30 SEC	MAX TPT DURING START 980 °	TEST OBSERVER Cardwell	
RUN DOWN TIME 2 MIN 23 SEC	PURPOSE OF RUN To obtain starting data at +59°F.			BAR. READING 30.11" Hga
TIME	RPM	REMARKS		
0810	0	NOTE: Cartridge lot OL-6-463 batch no. B95D-12 at ambient temperature will be used on this start.		
0812	5100	The engine fired at 1300 rpm with 800 pph fuel flow. The peak fuel flow was 1970 pph. The peak starter breach pressure was 850 psig with an average of 810 psig. The burn time was approximately 16 seconds. This was not an automatic start but throttle was opened at approx 800 rpm.		
		Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 16
DATE 18 August 1967	TEST TEMPERATURE (°F) 0	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0803	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0805	
TEST OPERATOR Cover	BAR. TEMPERATURE +78°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :02	
HRS COLD SOAK PRIOR TO START 20	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :42	
TIME TO FIRE MIN 15.2 SEC	TIME TO REACH 5000 RPM MIN 48 SEC	MAX TPT DURING START 830°	TEST OBSERVER Cardwell	
RUN DOWN TIME 1 MIN 62 SEC	PURPOSE OF RUN To obtain data at 0°F.		BAR. READING 30.08:Hg	
TIME	RPM	REMARKS		
0803	0	The engine fired at 1150 rpm with 750 pph fuel flow. The peak fuel flow was 1950 pph. The starter air pressure was 41 psig and starter switch was cut out manually at 3000 rpm and 37 seconds. The peak air temp before the starter air valve was 285°F.		
0805	5100	Shut down.		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 17
DATE 21 August 1967	TEST TEMPERATURE (°F) 0	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0811	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0813	
TEST OPERATOR GOWEY	AIR TEMPERATURE +80°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :02	
HRS COLD SOAK PRIOR TO START 72	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :44	
TIME TO FIRE MIN 17 SEC	TIME TO REACH 3000 RPM MIN 52 SEC	MAX TPT DURING START 920 °F	TEST OBSERVER Cardwell	
RUN DOWN TIME 1 MIN 42 SEC	PURPOSE OF RUN To obtain starting data at 0°F.		BAR. READING 29.85" Hgs	
TIME	RPM	REMARKS		
0811		The engine fired at 1200 rpm with 750 pph fuel flow. The peak fuel flow was 1840 pph. The starter air pressure was 40 psig with a peak air temp before the air valve of 285°F. The starter switch was cut out manually at 40 seconds and 3000 rpm.		
0813	5100	Shut down.		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 18
DATE 22 August 1967	TEST TEMPERATURE (°F) 0	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0904	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0906	
TEST OPERATOR Gower	AIR TEMPERATURE +82°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :02	
HRS COLD SOAK PRIOR TO START 24½	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :46	
TIME TO FIRE MIN 13.3 SEC	TIME TO REACH 5000 RPM MIN 50 SEC	MAX TPT DURING START 810 °F	TEST OBSERVER Cardwell	
RUN DOWN TIME 1 MIN 42 SEC	PURPOSE OF RUN To obtain data at 0°F.		BAR. READING 29.87"Hg a	
TIME	RPM	REMARKS		
0904	0	The engine fired at 1100 rpm with 750 pph fuel flow. The peak fuel flow was 1875 pph. The starter air pressure was 41 psig and peak air temp. before the air valve was 280°F. The starter switch was cut out manually at 3000 rpm and 38 seconds.		
0906	5060	Shut down.		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 19
DATE 23 August 1967	TEST TEMPERATURE (°F) 0	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0807	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0808	
TEST OPERATOR GOMER	BAR. TEMPERATURE +88°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :01	
HRS COLD SOAK PRIOR TO START 23	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :47	
TIME TO FIRE MIN SEC 11.8	TIME TO REACH 5100 RPM MIN SEC 39SEC	MAX TPT DURING START 835 °F	TEST OBSERVER Cardwell	
RUN DOWN TIME MIN SEC 1 29	PURPOSE OF RUN To obtain starting data at 0°F.		BAR. READING 29.93" Hg	
TIME	RPM	REMARKS		
0807	0	NOTE: Cartridge lot OL-10-94 hatch no. B290C-445 soaked 24½ hr at 0°F. This is a MXU-4A/A cartridge.		
0808	5080	The engine fired at 1220 rpm with 720 pph fuel flow. The peak fuel flow was 1920 pph. The average breech pressure was approx 790 psig with burn out at 19 seconds. The highest breech pressure occurred just prior to burn out at 810 psig. The throttle was pre-set prior to start initiation.		
		Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 24 August 1967		TEST TEMPERATURE (°F) 0	FUEL MIL-J-5161F Grade 1	RUN NO. 20
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 1336	
TEST OPERATOR GOWET	AIR TEMPERATURE +34°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :01	
HRS COLD SOAK PRIOR TO START 29	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :48	
TIME TO FIRE MIN 8.8 SEC	TIME TO REACH 5000 RPM MIN 34 SEC	MAX TPT DURING START 795 °F	TEST OBSERVER Cardwell	
RUN DOWN TIME 1 MIN 39 SEC	PURPOSE OF RUN To obtain starting data at 0°F.			BAR. READING 30.00" Hga
TIME	RPM	REMARKS		
1335	0	NOTE: Cartridge lot OL-6-463 batch no. B95D-10 soaked 30 hrs at 0°F. Cartridge type MXU-4/A.		
1336	5080	The engine fired at 1080 rpm with 760 pph fuel flow. The peak fuel flow was 1830 pph. The peak starter breach pressure was 910 psig with average pressure from 775 to 800 psig. Burn time was approx 19 seconds. The peak pressure occurred just after cartridge fired. The throttle was pre-set.		
		Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 25 August 1967		TEST TEMPERATURE (°F) 0	FUEL MIL-J-5151F Grade 1	RUN NO. 21
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STARTED 0838	
TEST OPERATOR GOWAT	BAR. TEMPERATURE +80°F	RELATIVE HUMIDITY %	TIME ENGINE STOPPED 0839	
HRS COLD SOAK PRIOR TO START 19	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME OF RUN :01	
TIME TO FIRE MIN 9.3 SEC	TIME TO REACH 5000 RPM MIN 35 SEC	MAX TPT DURING START 740°	TOTAL TIME ON ENGINE :49	
RUN DOWN TIME 1 MIN 34 SEC	PURPOSE OF RUN			TEST OBSERVER Cardwall
			BAR. READING 30.00" Hga	
TIME	RPM	REMARKS		
0838	0	NOTE: Cartridge lot OL-6-463 batch no. B95D-5 soaked 25 hrs at 0°F. Cartridge type MKU-4/A.		
0839	5080	The engine fired at 1080 rpm with 720 pph fuel flow. The peak fuel flow was 1910 pph. The peak starter breach pressure was 910 psig just after the cartridge fired. The average pressure was 810 psig with burn out at approx 18 seconds. Tho throttle was pre-set.		
		Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL		ENGINE SERIAL NO.		RUN NO.
J79-GE-5C		GE-033585		22
DATE	TEST TEMPERATURE (°F)	FUEL	TIME ENGINE STARTED	
28 August 1967	Amb. +75°F	MIL-J-5161F Grade 1	1049	
FUEL SYSTEM USED	LUBE OIL GRADE	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED	
Normal	MIL-L-7808F		1054	
TEST OPERATOR	BAR. TEMPERATURE	RELATIVE HUMIDITY %	TOTAL TIME OF RUN	
Gooley	86°F		:05	
HRS COLD SOAK PRIOR TO START	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE	
None			:54	
TIME TO FIRE MIN SEC	TIME TO REACH MIN SEC	MAX TPT DURING START	TEST OBSERVER	
15.5	5000 RPM MIN 51 SEC	1140 °F	Gooley	
RUN DOWN TIME 2 MIN 30 SEC	PURPOSE OF RUN		BAR. READING	
	To remove moisture from engine.		30.03" Hga	
TIME	RPM	REMARKS		
1049	0	NOTE: The engine has been subjected to high humidity since the last run at 0°F and this run is being made to dry the engine before lowering the temperature to -20°F.		
		Starter on: The engine fired at 1100 rpm with a fuel flow of 685 pph and a peak fuel flow of 1830 pph. The starter air pressure was 36 psig and starter air temperature was 360°F. The start switch was released at 3000 rpm in 39 seconds.		
1054	5100	Shut down.		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GX-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 23
DATE 29 August 1967	TEST TEMPERATURE (°F) -20°F	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0809	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0811	
TEST OPERATOR GOWER	BAR. TEMPERATURE 82°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :02	
HRS COLD SOAK PRIOR TO START 11	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :56	
TIME TO FIRE MIN 16 SEC	TIME TO REACH 5000 RPM MIN 85 SEC	MAX TPT DURING START 760 °P	TEST OBSERVER Goolsby	
RUN DOWN TIME 2 MIN 29 SEC	PURPOSE OF RUN To obtain starting data at -20°F.			BAR. READING 30.02" Hga
TIME	RPM	REMARKS		
0809	0	Starter on: The engine fired at 1050 rpm and a fuel flow at fire of 740 pph and a peak fuel flow of 1900 pph. The starter air valve was approx 4 seconds in opening after start switch was turned on. The starter air pressure was 38 psig and starter air temperature was 283°F. The start switch was released in 64 seconds at 3000 rpm.		
0811	5040	Shut down.		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL T79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 24
DATE 30 August 1967	TEST TEMPERATURE (°F) -20°F	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0928	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7080F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0930	
TEST OPERATOR Gower	BAR. TEMPERATURE 86°F	REL. HUMIDITY %	TOTAL TIME OF RUN :02	
HRS COLD SOAK PRIOR TO START 13	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE :58	
TIME TO FIRE MIN 12.8 SEC	TIME TO REACH 5000 RPM MIN 15 SEC	MAX TPT DURING START 795 °F	TEST OBSERVER Goolsby	
RUN DOWN TIME 2 MIN 30 SEC	PURPOSE OF RUN To obtain starting data.		BAR. READING 29.96" Hga	
TIME	RPM	REMARKS		
0928	0	<p>NOTE: This start will be made by placing the throttle in idle position before engaging the start switch. (The same start procedure used in making a cartridge start).</p> <p>Starter on: The engine fired at 1070 rpm with 700 pph fuel flow and a peak fuel flow of 1880 pph. The starter air pressure was 41 psig at 300°F. The start switch was released at 66 seconds at 3000 rpm.</p> <p>There was a 3 second delay in the opening of the air valve.</p>		
0930	5040	Shut down.		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 25
DATE 31 August 1967	TEST TEMPERATURE (°F) -20°F	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0817	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0819	
TEST OPERATOR Gowaz	BAR. TEMPERATURE 84°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :02	
HRS COLD SOAK PRIOR TO START 15	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE 1:00	
TIME TO FIRE MIN 11 SEC	TIME TO REACH 5000 RPM MIN 77 SEC	MAX TPT DURING START 660 °F	TEST OBSERVER Gooleyby	
RUN DOWN TIME 1 MIN 30 SEC	PURPOSE OF RUN To obtain starting data.		BAR. READING 29.97" Hg	
TIME	RPM	REMARKS		
0805	0	NOTE: Cartridge lot OL-6-463 batch no. B95C-4 soaked 24 hrs at -20°F. Cartridge type MKU-4/A.		
		Starter on: The cartridge did not fire. The circuit was checked and found to be good. The contacts were re-cleaned.		
		2nd Attempt:		
0817	0	Starter on: The engine light off occurred at 100 rpm with 710 pph fuel flow. The peak fuel flow was 2000 pph. The peak starter breach pressure was 925 psig and occurred at the start of the burn cycle. The average breach pressure was 750 psig. The cartridge burned out at 2375 rpm in approx 22 seconds.		
0819	5040	Shut down.		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 26
DATE 1 September 1967	TEST TEMPERATURE (°F) -20°F	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0812	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0814	
TEST OPERATOR Gower	BAR. TEMPERATURE 76°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :02	
HRS COLD SOAK PRIOR TO START 16	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE 1:02	
TIME TO FIRE MIN 11 SEC	TIME TO REACH 5000 RPM MIN 80 SEC	MAX TPT DURING START 630"	TEST OBSERVER Goolsby	
RUN DOWN TIME 1 MIN 28 SEC	PURPOSE OF RUN To obtain start data at -20°F.		BAR. READING 30.02" Hga	
TIME	RPM	REMARKS		
		<p>NOTE: Prior to this start the starter air valve and the B-58 piping from the valve to the starter was removed. The air line from the MA-2 is connected directly to the starter and the air valve on the MA-2 will be used to control the air to the starter.</p> <p>The throttle will be pre-set prior to engaging to start switch.</p>		
0812	0	<p>Starter on: The engine fired at 1120 rpm with 700 pph fuel flow. The peak fuel flow was 1875 pph. The start switch was released at 3000 rpm in 61 seconds. The starter air pressure was 53 psig and starter air temperature was 280°F.</p>		
0814	5040	<p>Shut down.</p> <p>NOTE: The P&amp;D valve leakage was checked during the run and there was no leakage until the engine was shut down.</p>		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL <b>J79-GE-5C Engine</b>		ENGINE SERIAL NO. <b>GE-033585</b>		<b>1</b>
DATE <b>8 September 1967</b>		TEST TEMPERATURE (°F) <b>Outside Air</b>	FUEL <b>MIL-J-5161F Grade 1</b>	RUN NO. <b>27</b>
FUEL SYSTEM USED <b>Normal</b>		LUBE OIL GRADE <b>MIL-L-7808F</b>	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STARTED <b>1330</b>
TEST OPERATOR <b>GOWEN</b>		BAR. TEMPERATURE <b>+80°F</b>	RELATIVE HUMIDITY %	TIME ENGINE STOPPED <b>1334</b>
HRS COLD SOAK PRIOR TO START		FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME OF RUN <b>:04</b>
TIME TO FIRE MIN SEC <b>15</b>		TIME TO REACH <b>5100 RPM MIN 49 SEC</b>	MAX TPT DURING START <b>1090°</b>	TOTAL TIME ON ENGINE <b>1:06</b>
RUN DOWN TIME <b>2 MIN 62 SEC</b>		PURPOSE OF RUN <b>To check engine after fuel control change.</b>		TEST OBSERVER <b>Cardwell</b>
BAR. READING <b>29.90" Hg</b>				
TIME	RPM	REMARKS		
		<p>NOTE: Fuel control P/N 407070, S/N 577297 removed.</p> <p>Fuel control P/N 40405A, S/N 589794 installed. The fuel control has been modified by Woodward Governor Co. to counteract shift toward lean position at cold temperatures and to reduce rumble.</p> <p>The starter air valve and the B-58 piping from the valve to the starter has been installed.</p>		
1313	0	<p>Wet pre-start.</p> <p>The maximum cranking speed was 1320 rpm and fuel flow was 700 pph. The starter air pressure was 36 psig.</p>		
1330	0	<p>The engine fired at 1200 rpm with 650 pph fuel flow. The peak fuel flow was 1905 pph. The average starter air pressure was 37½ psig with a peak air temp before the valve of 417°F. The starter switch was cut manually at 3000 rpm and 37 seconds.</p>		
1334	5120	<p>Shut down.</p>		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 8 September 1967		TEST TEMPERATURE (°F) Outside Air +80°F		RUN NO. 28
FUEL SYSTEM USED Normal		FUEL MIL-J-5161F Grade 1		TIME ENGINE STARTED 1356
TEST OPERATOR Gower		LUBE OIL GRADE MIL-L-7808F		TIME ENGINE STOPPED 1358
HRS COLD SOAK PRIOR TO START		BAR. TEMPERATURE +78°F		NO. LBS. OF OIL USED DURING RUN
TIME TO FIRE MIN 12.8 SEC		RELATIVE HUMIDITY %		TOTAL TIME OF RUN :02
TIME TO REACH 5100 RPM MIN 42 SEC		MAXIMUM CRANKING RPM		TOTAL TIME ON ENGINE 1:08
MAX TPT DURING START 1150°		TEST OBSERVER Cardwell		
PURPOSE OF RUN To obtain starting data.		BAR. READING 29.90" Hgs		
TIME	RPM	REMARKS		
1356	0	The engine fired at 1140 rpm with 630 pph fuel flow. The peak fuel flow was 2000 pph. The starter air pressure was 38 psig and starter was cut out at 3000 at 38 seconds. The peak starter air temperature was 390°F.		
1358	5180	Shut down.		

OBSERVERS LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 9 September 1967		TEST TEMPERATURE (°F) -20°F	FUEL MIL-J-5161F Grade 1	RUN NO. 29
FUEL SYSTEM USED Normal		LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 1408
TEST OPERATOR GOWSE		AIR TEMPERATURE +75°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :02
HRS COLD SOAK PRIOR TO START Total Soak 21		FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE 1:10
TIME TO FIRE MIN 14.2 SEC		TIME TO REACH 5060 RPM MIN 54 SEC	MAX TPT DURING START 765 °F	TEST OBSERVER Cardwell
RUN DOWN TIME MIN 30 SEC		PURPOSE OF RUN To obtain starting data.		BAR. READING 29.81" Hga
TIME	RPM	REMARKS		
1406	0	NOTE: The main fuel control CDP reference drain line disconnected on run no. 8 has been connected for normal configuration.		
1408	5060	The engine fired at 1180 rpm with 650 pph fuel flow. The peak fuel flow was 1980 pph. There was an approximate delay of 3 seconds in starter air valve opening. The average air pressure was 47 psig and peak air temperature before the valve was 286°F. The starter switch was manually cut out at 3000 rpm and 42 seconds.		
		Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 10 September 1967		TEST TEMPERATURE (°F) -20°F	FUEL MIL-J-5161F Grade 1	RUN NO. 30
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STARTED 1405	
TEST OPERATOR Gower	BAR. TEMPERATURE +78°F	RELATIVE HUMIDITY %	TIME ENGINE STOPPED 1407	
HRS COLD SOAK PRIOR TO START 23 3/4	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME OF RUN :02	
TIME TO FIRE MIN 12.5 SEC	TIME TO REACH 5060 RPM MIN 52 SEC	MAX TPT DURING START 745 °P	TOTAL TIME ON ENGINE 1:12	
RUN DOWN TIME 1 MIN 27 SEC	PURPOSE OF RUN To obtain starting data at -20°F.		TEST OBSERVER Cardwell	
		BAR. READING 29.88" Hga		
TIME	RPM	REMARKS		
1405	0	<p>NOTE: Cartridge lot OL-6-463 batch no. B95C-451 soaked 25 3/4 hrs at -20°F. Cartridge type MXU-4/A.</p> <p>The engine fired at 1200 rpm with 550 pph fuel flow. The peak fuel flow was 1950 pph. There was a delay in breech pressure indication. Speed began to increase before there was an indication of breech pressure. The breech pressure was approx 800 psig.</p>		
1407	5060	<p>NOTE: The leakage from the P&amp;D valve appeared to be excessive during the start.</p> <p>Shut down.</p>		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 11 Sept 1967		TEST TEMPERATURE (°F) -20°F		RUN NO. 31
FUEL SYSTEM USED Normal		FUEL MIL-J-5161F Grade 1		TIME ENGINE STARTED 0805
TEST OPERATOR Gover		LUBE OIL GRADE MIL-L-7808F		TIME ENGINE STOPPED 0807
HRS COLD SOAK PRIOR TO START Total soak 18 hrs.		BAR. TEMPERATURE +76°F		NO. LBS. OF OIL USED DURING RUN
TIME TO FIRE MIN 21.5 SEC		RELATIVE HUMIDITY %		TOTAL TIME OF RUN :02
RUN DOWN TIME MIN 1 SEC 35		PT LBS BREAK AWAY TORQUE		TOTAL TIME ON ENGINE 1:14
TIME TO REACH 5060 RPM MIN 42 SEC		MAXIMUM CRANKING RPM		TEST OBSERVER Cardwell
PURPOSE OF RUN To obtain data at -20°F.		MAX TPT DURING START 720 °		BAR. READING 29.99" Hga
TIME	RPM	REMARKS		
0805	0	<p>NOTE: The starter air valve and R-58 piping from the valve to the starter has been removed. The MA-2 air line connects to the starter with the MA-2 valve controlling air pressure.</p> <p>The engine fired at 1200 rpm with 650 pph fuel flow. The peak fuel flow was 1950 pph. The starter air pressure was 53 psig with a peak temperature of 267°F. The starter switch was cut manually at 32 seconds and 3000 rpm.</p> <p>The P&amp;D drain valve leakage appeared to be excessive on the previous run so the drain line was solenoid closed for this start.</p>		
0807	5060	Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL		ENGINE SERIAL NO.		1
J79-GE-5C		GE-033585		32
DATE	TEST TEMPERATURE (°F)	FUEL	TIME ENGINE STARTED	
12 Sept 1967	-40°F	MIL-J-5161F Grade 1	0814	
FUEL SYSTEM USED	LUBE OIL GRADE	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED	
Normal	MIL-L-7808F		0815	
TEST OPERATOR	BAR. TEMPERATURE	RELATIVE HUMIDITY %	TOTAL TIME OF RUN	
Gowex	+74°F		:01	
HRS COLD SOAK PRIOR TO START	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE	
21½			1:15	
TIME TO FIRE	TIME TO REACH	MAX TPT DURING START	TEST OBSERVER	
MMH 13.5 SEC	5000 RPM MMH 53 SEC	750 °F	Cardwell	
RUN DOWN TIME	PURPOSE OF RUN	BAR. READING		
1 MMH 10 SEC	To obtain data at -40°F.	30.03" Hgs		
TIME	RPM	REMARKS		
0814	0	<p>NOTE: Cartridge lot OL-6-463 batch no. B95C-453 soaked 21½ hrs at -40°F. Cartridge type MXU-4/A.</p> <p>The engine fired at 1160 rpm with 630 pph fuel flow. The peak fuel flow was 1950 pph. The peak starter breech pressure was 950 psig and average pressure was approx 785 psig. The burn time was approximate 21 seconds.</p> <p>NOTE: The P&amp;D valve drain line was solenoid closed for the start, and will remain closed on subsequent starts, being opened after reaching idle speed.</p>		
0815	5050	<p>Shut down.</p> <p>NOTE: There was an oil leak around the pump, exact location could not be determined. Leakage amounted to approx 1 qt.</p>		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL		ENGINE SERIAL NO.		RUN NO.
179-GE-5C		GE-033-585		33
DATE	TEST TEMPERATURE (°F)	FUEL	TIME ENGINE STARTED	
12 Sept 1967	-40°F	MIL-J-5161F Grade 1	0851	
FUEL SYSTEM USED	LUBE OIL GRADE	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED	
Normal	MIL-L-7898F		0852	
TEST OPERATOR	BAR. TEMPERATURE	RELATIVE HUMIDITY %	TOTAL TIME OF RUN	
Gowet	+75°F		:01	
WAS COLD SOAK PRIOR TO START	PT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE	
			1:16	
TIME TO FIRE MIN SEC	TIME TO REACH 5000 RPM MIN SEC	MAX TPT DURING START	TEST OBSERVER	
11	39	640	Cardwell	
RUN DOWN TIME 1 MIN 22 SEC	PURPOSE OF RUN			BAR. READING
	To check oil leakage			30.03" Hga
TIME	RPM	REMARKS		
0851	0	NOTE: The MA-2 will be used for this start.  The engine fired at 1280 rpm with 630 pph fuel flow. The peak fuel flow was 1968 pph. The starter air pressure was 57½ psig with a peak temperature of 282°F. The starter switch was manually cut out at 3000 rpm and 29 seconds.		
0852	5040	Shut down.  NOTE: There was no oil leakage noted on this run. The leak on the previous run may have been due to high oil pressure after the soak at -40°F.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		1
DATE 12 Sept 1967		TEST TEMPERATURE (°F) -40°F		RUN NO. 34
FUEL SYSTEM USED Normal		LUBE OIL GRADE MIL-L-7808F		TIME ENGINE STARTED 1929
TEST OPERATOR GOWET		BAR. TEMPERATURE 79°F		TIME ENGINE STOPPED 19:3025
HRS COLD SUAK PRIOR TO START 10½		FT LBS BREAK AWAY TORQUE		RELATIVE HUMIDITY % :02
TIME TO FIRE MIN 14 SEC		TIME TO PEACH- 5000 RPM MIN 50 SEC		TOTAL TIME OF RUN 1:18
RUN DOWN TIME MIN SEC		PURPOSE OF RUN To obtain starting data at -40°F.		TOTAL TIME ON ENGINE 1:18
TIME		RPM		REMARKS
				<p>NOTE: Information has been received from General Electric Co. on changes made to improve fuel flow stability at low temperatures on the fuel control installed on run no. 27.</p> <p>The number of holes in the differential pilot valve bushing was reduced from 4 to 2. This reduction in porting holes reduces the pilot valve gain.</p> <p>A new orifice assy. was inserted into the drilled passage which supplies the main fuel pump discharge pressure signal to the differential pilot valve. The new orifice assy. is of the standpipe design and contains eight .025 inch diameter holes supplying a .040 inch diameter controlling orifice. The new orifice assy. serves to dampen the pilot valve rendering it less sensitive to pulsations in main fuel pump discharge pressure.</p> <p>The following changes were made to improve temperature compensation:</p> <ol style="list-style-type: none"> <li>1. A close clearance fuel valve was added.</li> <li>2. Nitrogen filled P3 reference bellows was added.</li> </ol> <p>The starter air valve and B-58 piping from the valve to the starter has been installed.</p>
1929	0			The engine fired at 1100 rpm with 650 pph fuel flow. The peak fuel flow was 1980 pph. The starter air press was 47 psi with a peak temperature of 275°F. The starter switch was manually cut out at 3000 rpm and 49 seconds.
1930:25	5040			<p>Shut down; due to oil leak.</p> <p>NOTE: The oil leak was at the split line between the two pumps.</p>

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 35
DATE 13 Sept 1967	TEST TEMPERATURE (°F) -65°F	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0912	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0913	
TEST OPERATOR Gower	AIR TEMPERATURE +78°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :01	
HRS COLD SOAK PRIOR TO START See log.	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE 1:19	
TIME TO FIRE MIN 19 SEC	TIME TO REACH 5000 RPM MIN 51 SEC	MAX TPT DURING START 720°	TEST OBSERVER Cardwell	
RUN DOWN TIME MIN SEC	PURPOSE OF RUN To obtain starting data at -65°F.			AIR. READING 30.02" Hga
TIME	RPM	REMARKS		
0859	0	<p>NOTE: Due to limited time available to finish test the engine will be run without repairing oil leak.</p> <p>There was a soak of 10 hrs at -65°F before the first attempt.</p> <p>The engine was cranked for 30 seconds with no indication of engine light-off. The starter air pressure was 46 psig with peak temperature of 225°F. Maximum cranking was 1260 rpm. The fuel flow was 600 pph.</p> <p>NOTE: The engine was motored to blow out raw fuel.</p> <p>2nd attempt:</p>		
0906	0	<p>The engine was cranked for 26 seconds with no indication of engine firing. The starter air pressure was 46 psig and maximum air temperature was 282°F. The fuel flow was 610 gph and fuel manifold pressure was 52 psig.</p> <p>NOTE: The engine was motored to blow out raw fuel.</p> <p>3rd attempt:</p>		
0912	0	<p>The engine fired at 1380 rpm with 650 pph fuel flow. The peak fuel flow was 1980 pph. The starter air pressure was 46 psig and starter air temperature was 288°F. The starter switch was cut manually at 39 seconds and 3000 rpm.</p> <p>The throttle was pre-set to idle position and moved from idle position to 25 degrees at 14 seconds. The throttle was returned to idle position after engine fired and before 3000 rpm.</p>		
0913	5040	Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-03358,		1
DATE 13 Sept 1967		TEST TEMPERATURE (°F) -65°F	FUEL MIL-J-5161F Grade 1	RUN NO. 36
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7080F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STARTED 1908	
TEST OPERATOR Gower	AIR TEMPERATURE +82°F	RELATIVE HUMIDITY %	TIME ENGINE STOPPED 1909	
HRS COLD SOAK PRIOR TO START 9 3/4	PT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME OF RUN :01	
TIME TO FIRE MIN 14 SEC	TIME TO REACH- 5060 RPM MIN 46 SEC	MAX TPT DURING START 880 °F	TOTAL TIME ON ENGINE 1:20	
RUN DOWN TIME 1 MIN 5 SEC	PURPOSE OF RUN To obtain data at -65°F.			TEST OBSERVER Cardwell
BAR. READING 29.97" Hga				
TIME	RPM	REMARKS		
1908	0	<p>NOTE: Cartridge lot OL-10-94 batch no. B290C-182 soaked 21 hrs at -65°F. Cartridge type MXU-4A/A. The cartridge was soaked 3 hrs between -40°F and -65°F while test cell temperature was being lowered to -65°F.</p> <p>The engine fired at 1080 rpm with 620 pph fuel flow. The peak fuel flow was 2100 pph. The peak starter breach pressure was 850 psig with an average of approximately 750 psig. Burn time was approximately 20 seconds.</p> <p>NOTE: after the last run the secondary nozzle pump was removed from the main tube and scavenge pump and replaced with a new gasket. A hose from the seal drain to the scavenge return oil line was installed. No leakage was noted on the run.</p>		
1908:55	5060	Shut down.		

OBSERVER'S LOG				PAGE NO.
JET ENGINE MODEL		ENGINE SERIAL NO.		RUN NO.
J79-G8-5C		GE-033585		37
DATE	TEST TEMPERATURE (°F)	FUEL	TIME ENGINE STARTED	
14 Sept 1967	+135°F	MIL-J-5161F Grade 1	1912	
FUEL SYSTEM USED	LUBE OIL GRADE	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED	
Normal	MIL-L-7808F		1913	
TEST OPERATOR	BAR. TEMPERATURE	RELATIVE HUMIDITY %	TOTAL TIME OF RUN	
Gower	+77°F		:01	
HRS COLD SOAK PRIOR TO START	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE	
16 hrs			1:21	
TIME TO FIRE MIN SEC	TIME TO REACH MIN SEC	MAX TPT DURING START	TEST OBSERVER	
16	5100 RPM 55 SEC	1170°	Carr	
RUN DOWN TIME MIN SEC	PURPOSE OF RUN	BAR. READING		
1 40	To obtain data at +135°F.	29.94" Hga		
TIME	RPM	REMARKS		
1912	0	NOTE: The MA-2 will be used for this start. The engine was soaked at +160°F for 16 hrs and run at +135°F.		
1913	5000	The engine fired at 1100 rpm with 550 pph fuel flow. The peak fuel flow was 1900 pph. The peak starter air pressure was 32.5 psig with peak temp of 425°F. Shut down.		

OBSERVER'S LOG				PAGE NO. 1
JET ENGINE MODEL J79-GE-5C		ENGINE SERIAL NO. GE-033585		RUN NO. 38
DATE 15 Sept 1967	TEST TEMPERATURE (°F) Soak at +160°F. Run at +135°F.	FUEL MIL-J-5161F Grade 1	TIME ENGINE STARTED 0800	
FUEL SYSTEM USED Normal	LUBE OIL GRADE MIL-L-7808F	NO. LBS. OF OIL USED DURING RUN	TIME ENGINE STOPPED 0801	
TEST OPERATOR Gower	BAR. TEMPERATURE +78°F	RELATIVE HUMIDITY %	TOTAL TIME OF RUN :01	
HRS COLD SOAK PRIOR TO START 12 hrs at +160°F	FT LBS BREAK AWAY TORQUE	MAXIMUM CRANKING RPM	TOTAL TIME ON ENGINE 1:22	
TIME TO FIRE MIN 9.6 SEC	TIME TO REACH 5400 RPM MIN 39 SEC	MAX TPT DURING START 1130°	TEST OBSERVER Cardwell	
RUN DOWN TIME 3 MIN 21 SEC	PURPOSE OF RUN To obtain data at +135°F.		BAR. READING 30.00" Hga	
TIME	RPM	REMARKS		
0800	0	NOTE: Cartridge lot OL-10-94 batch no. B290C-183 soaked 24 hrs at +160°F. Cartridge type MXU-4A/A.		
0801	5400	The engine fired at 1300 rpm with 640 pph fuel flow. The peak fuel flow was 2100 pph. The peak starter breech pressure was 940 psig with an average of approximately 850 psig. Burn time was 14 seconds.		
		Shut down.		

**APPENDIX F**

**GRAPHS OF START DATA**

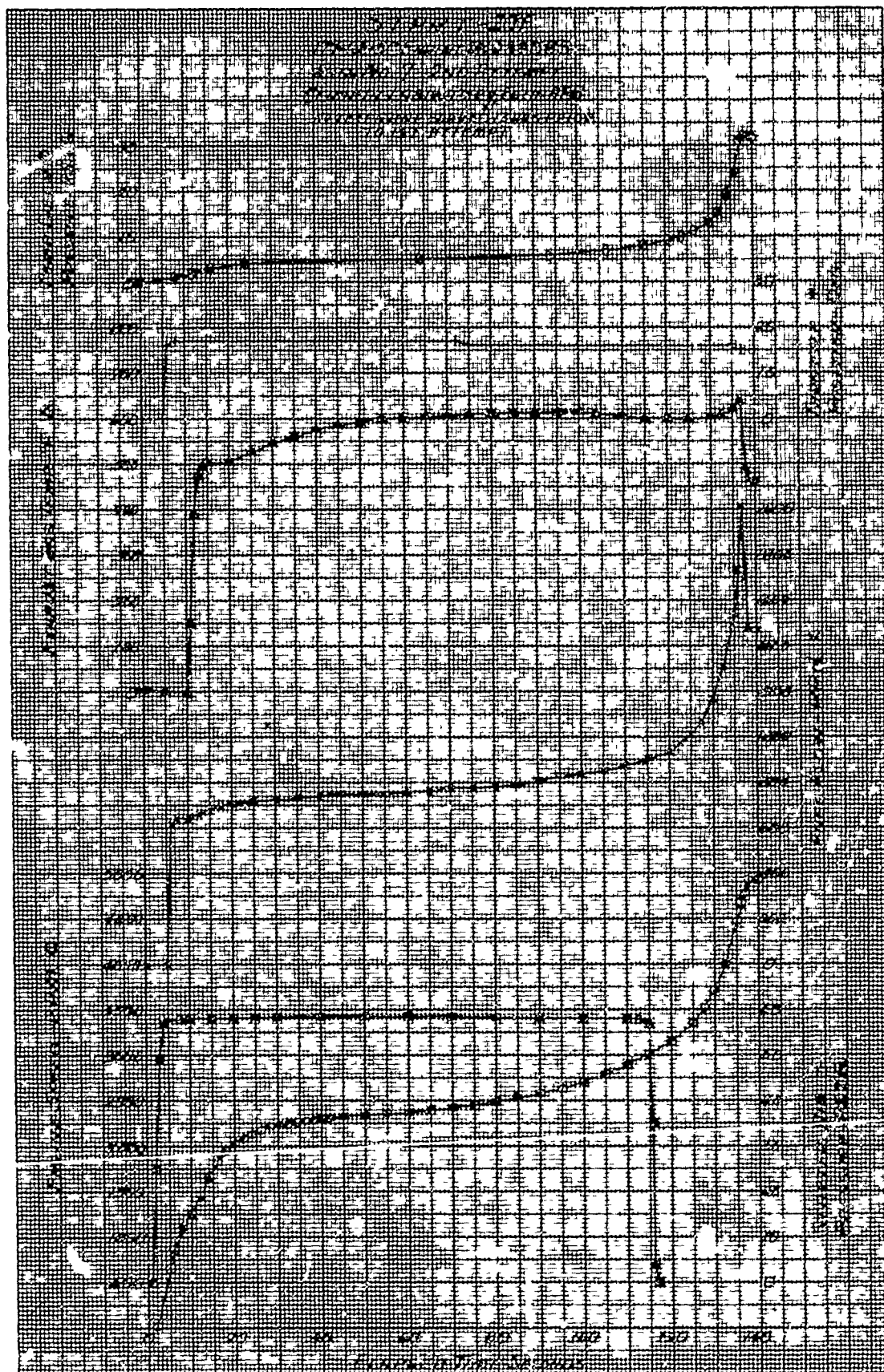


Fig. 6

F-1

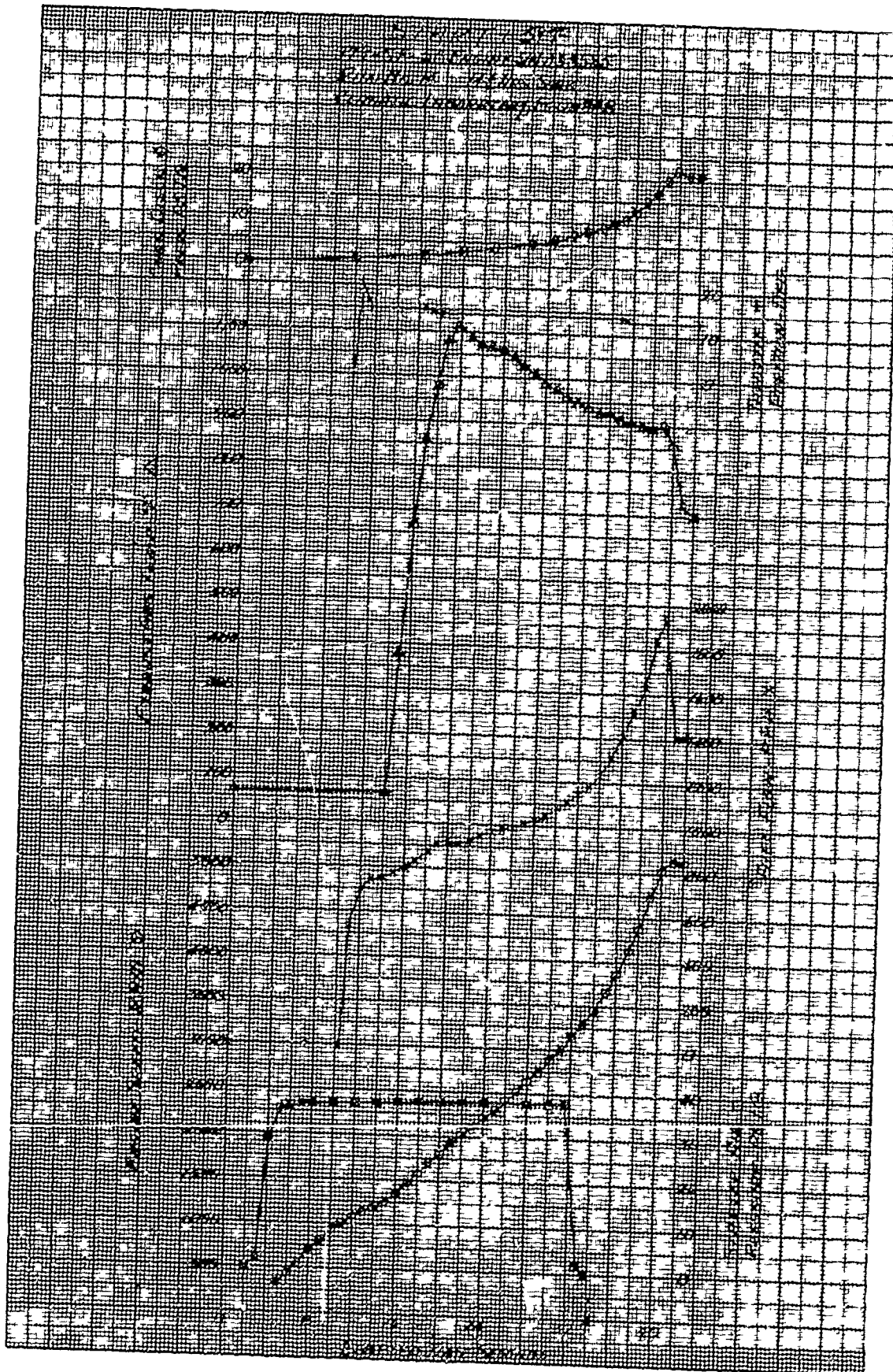


Fig. 7

R-2

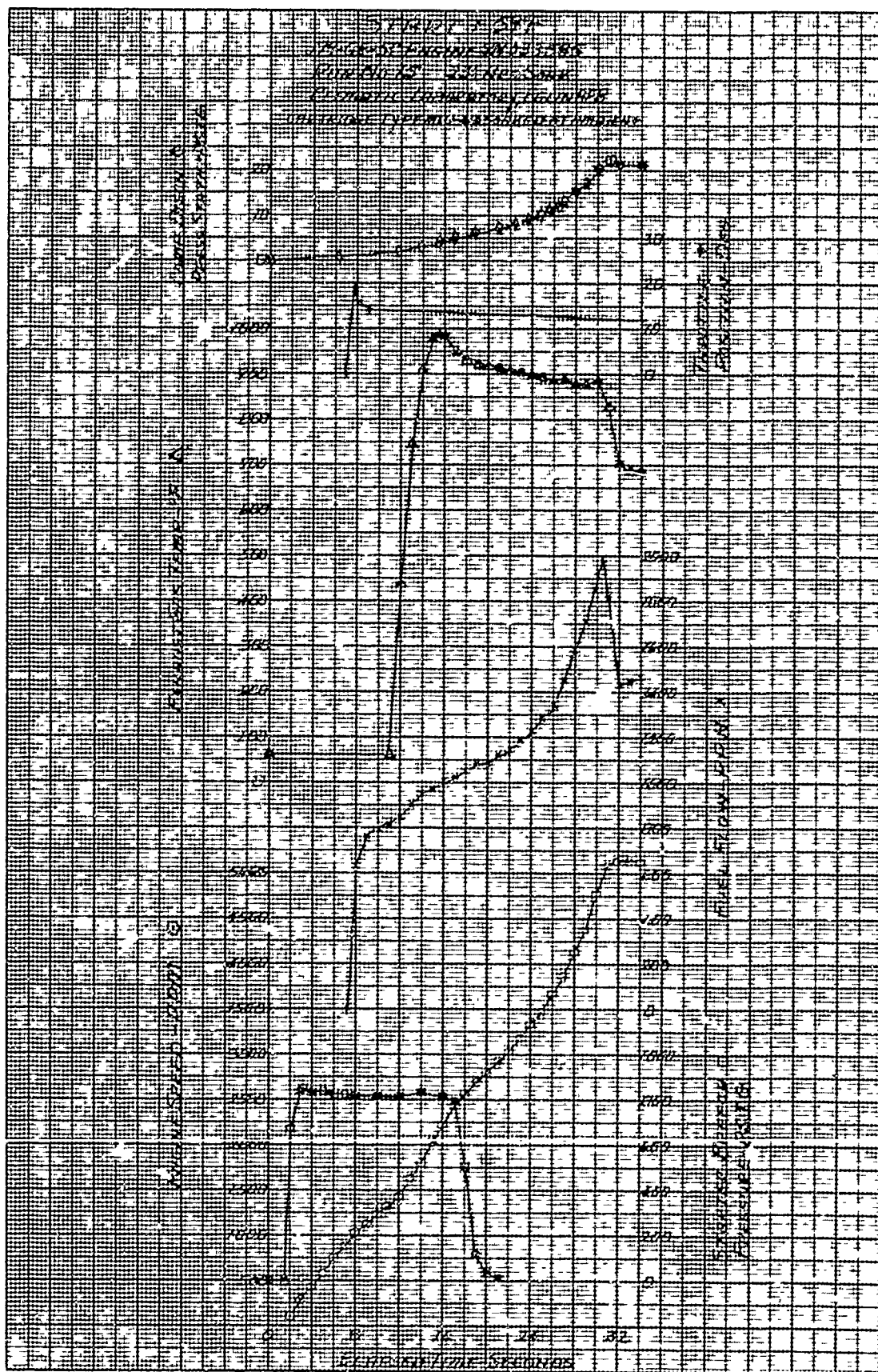


Fig. 8

[illegible]

**F-4**

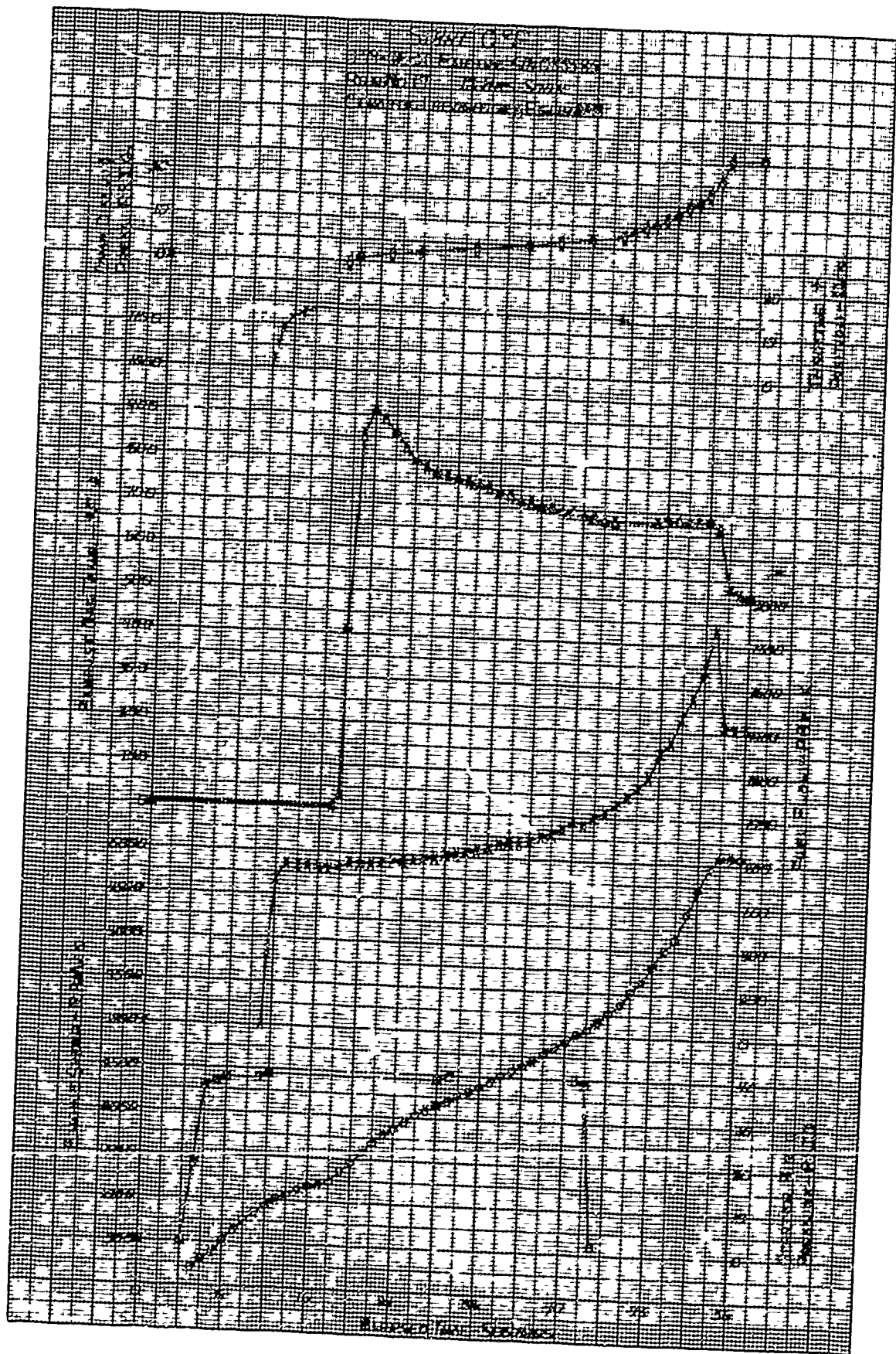


Fig. 10



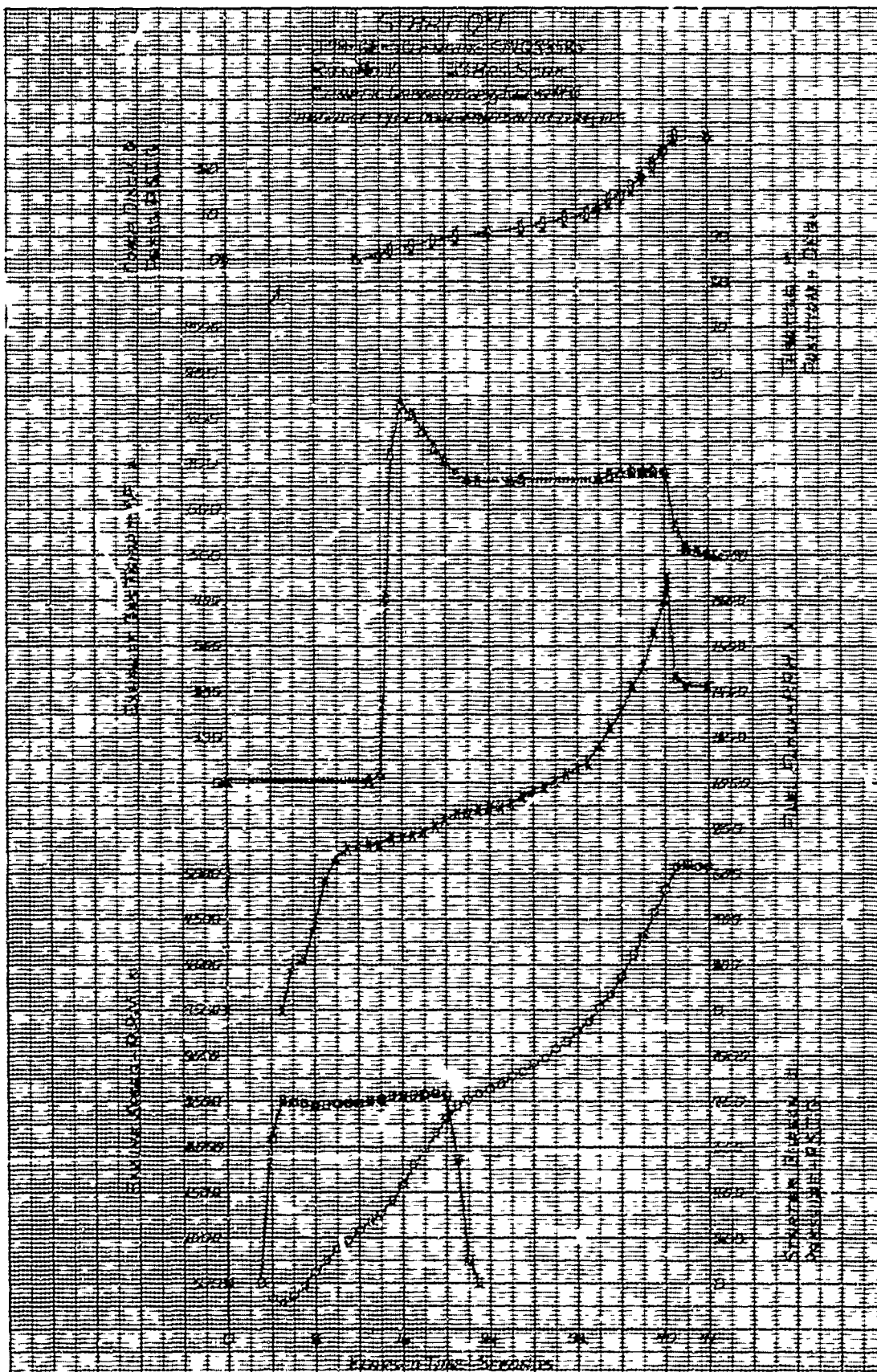


Fig. 12

**F-7**



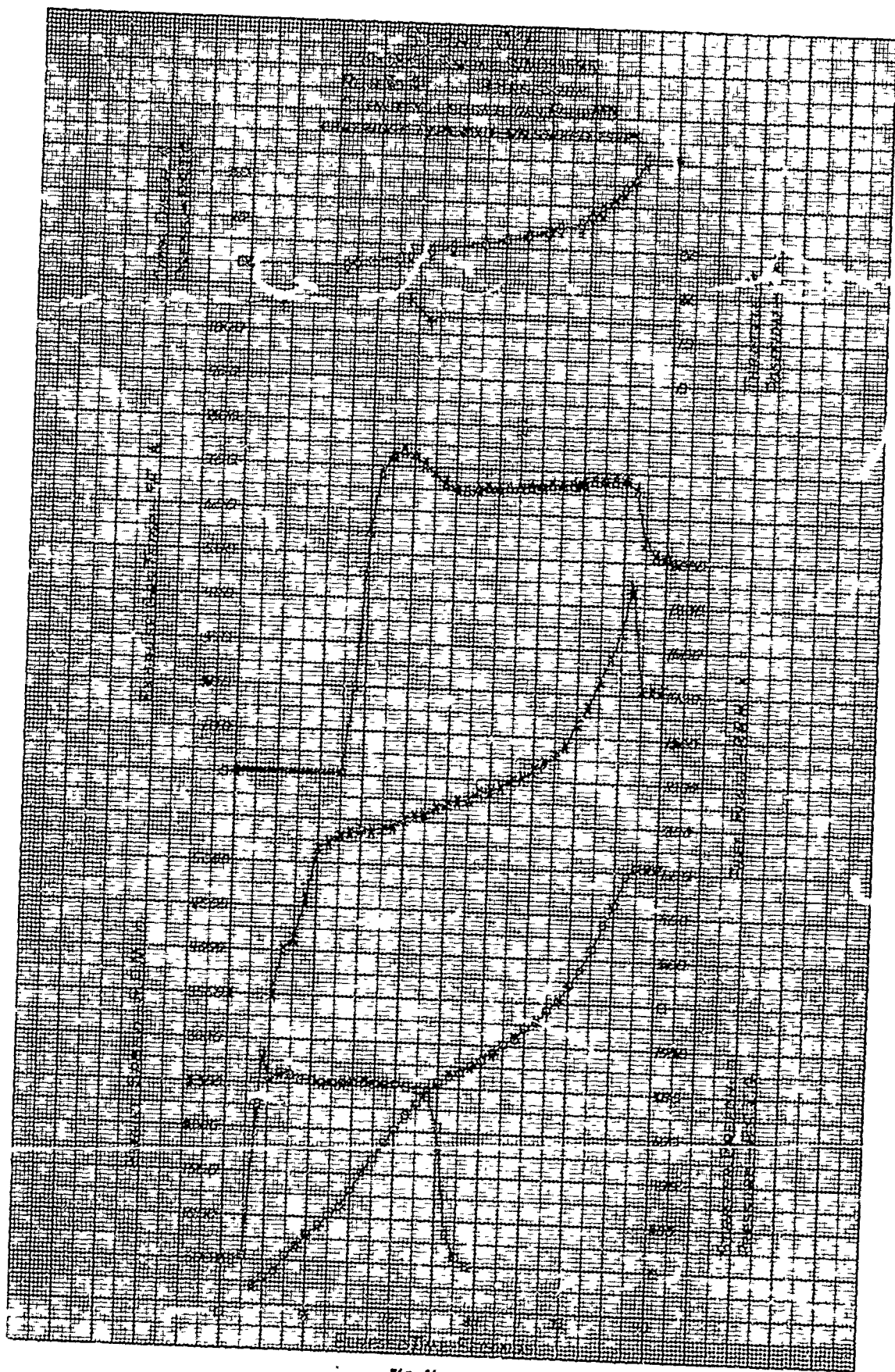


Fig. 14

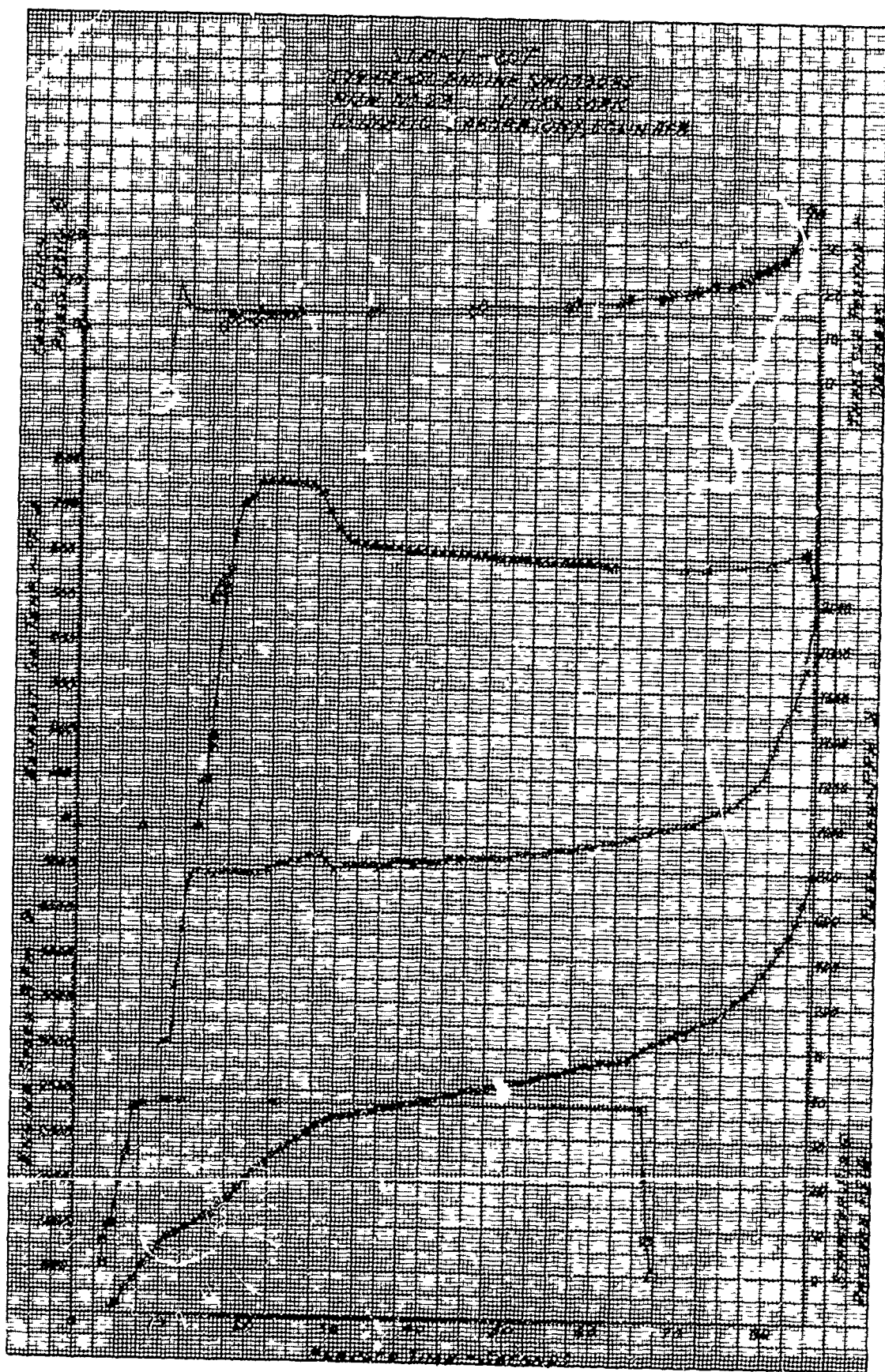


Fig. 15

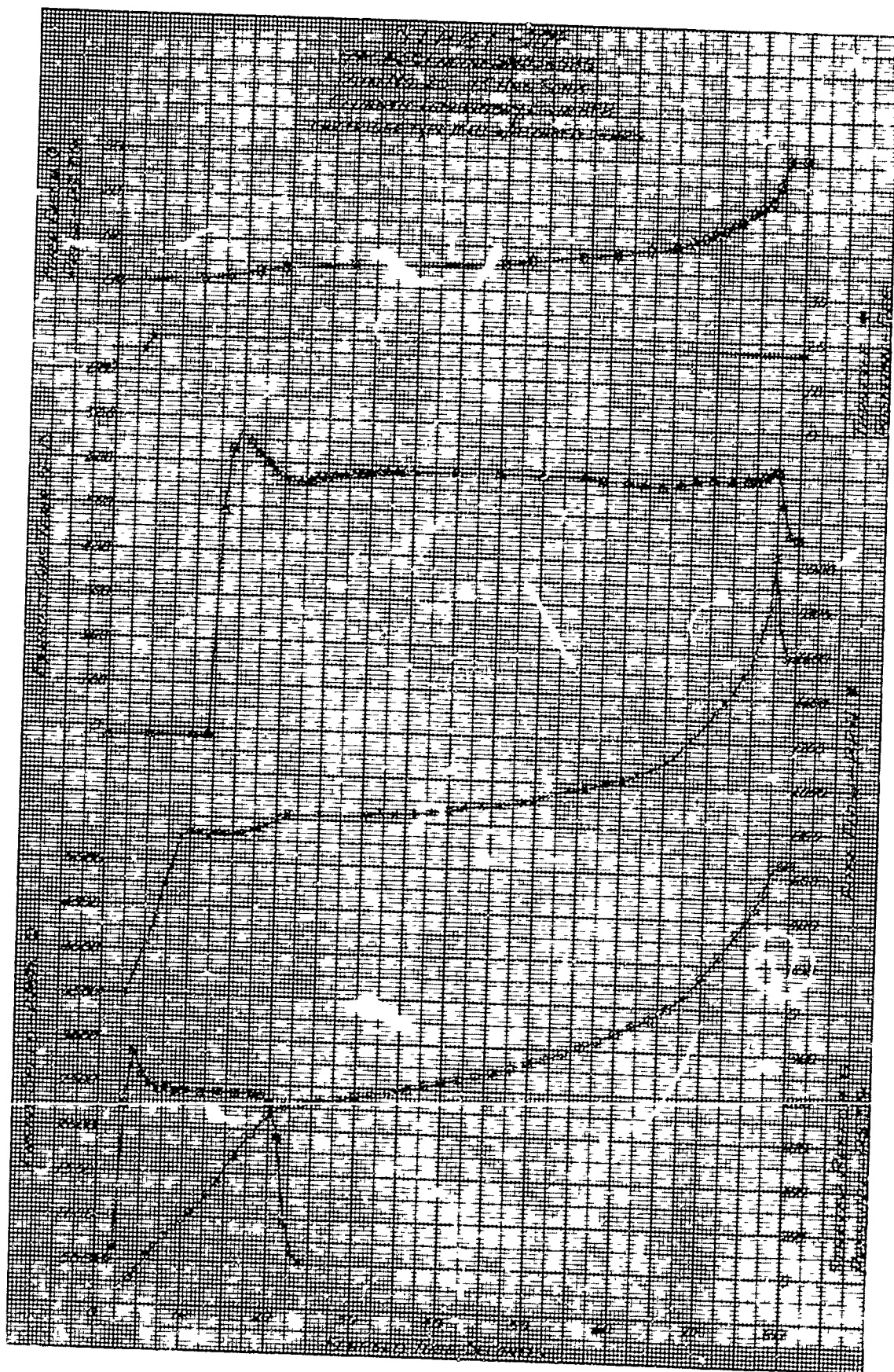


Fig. 16

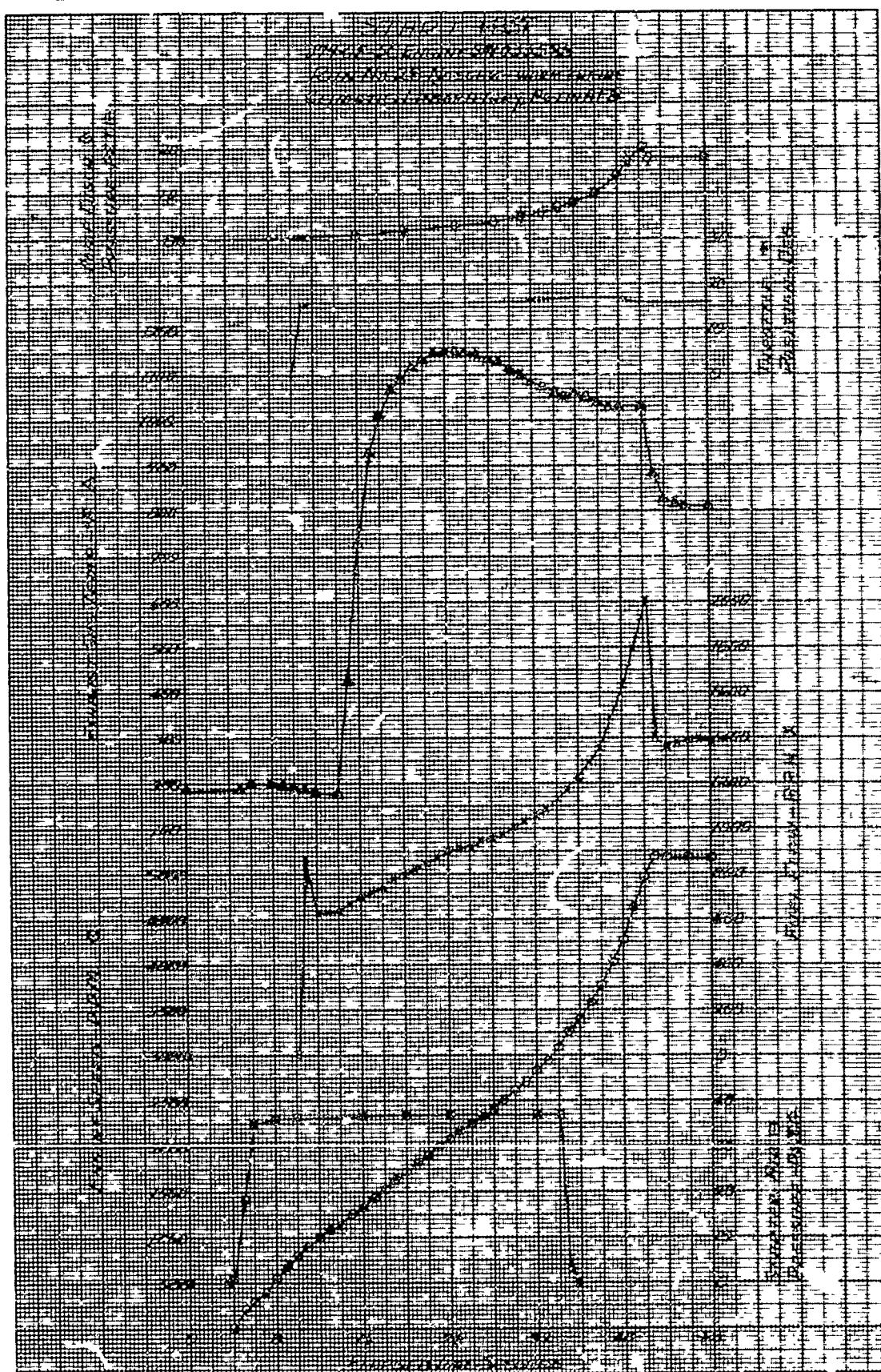
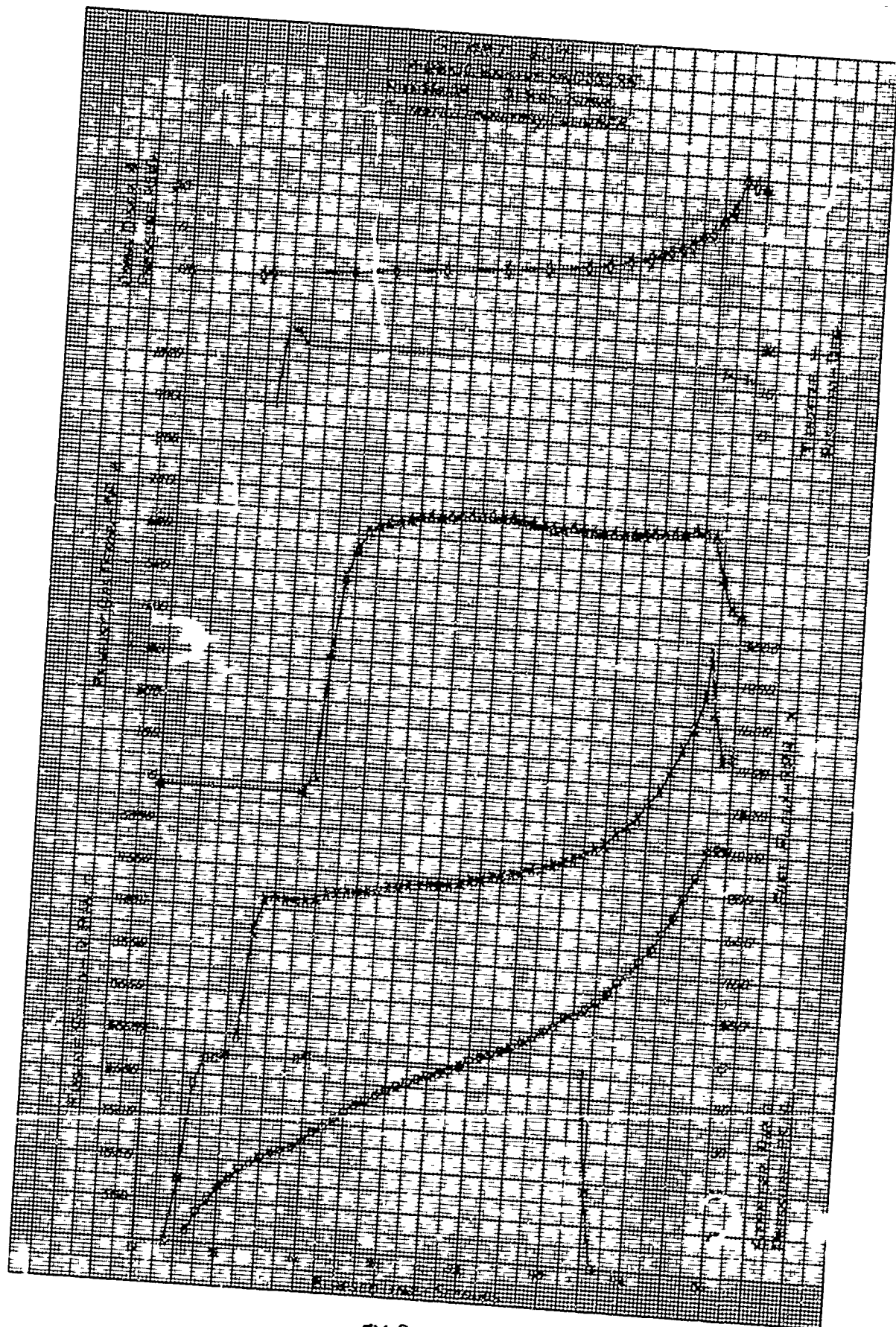


Fig. 17



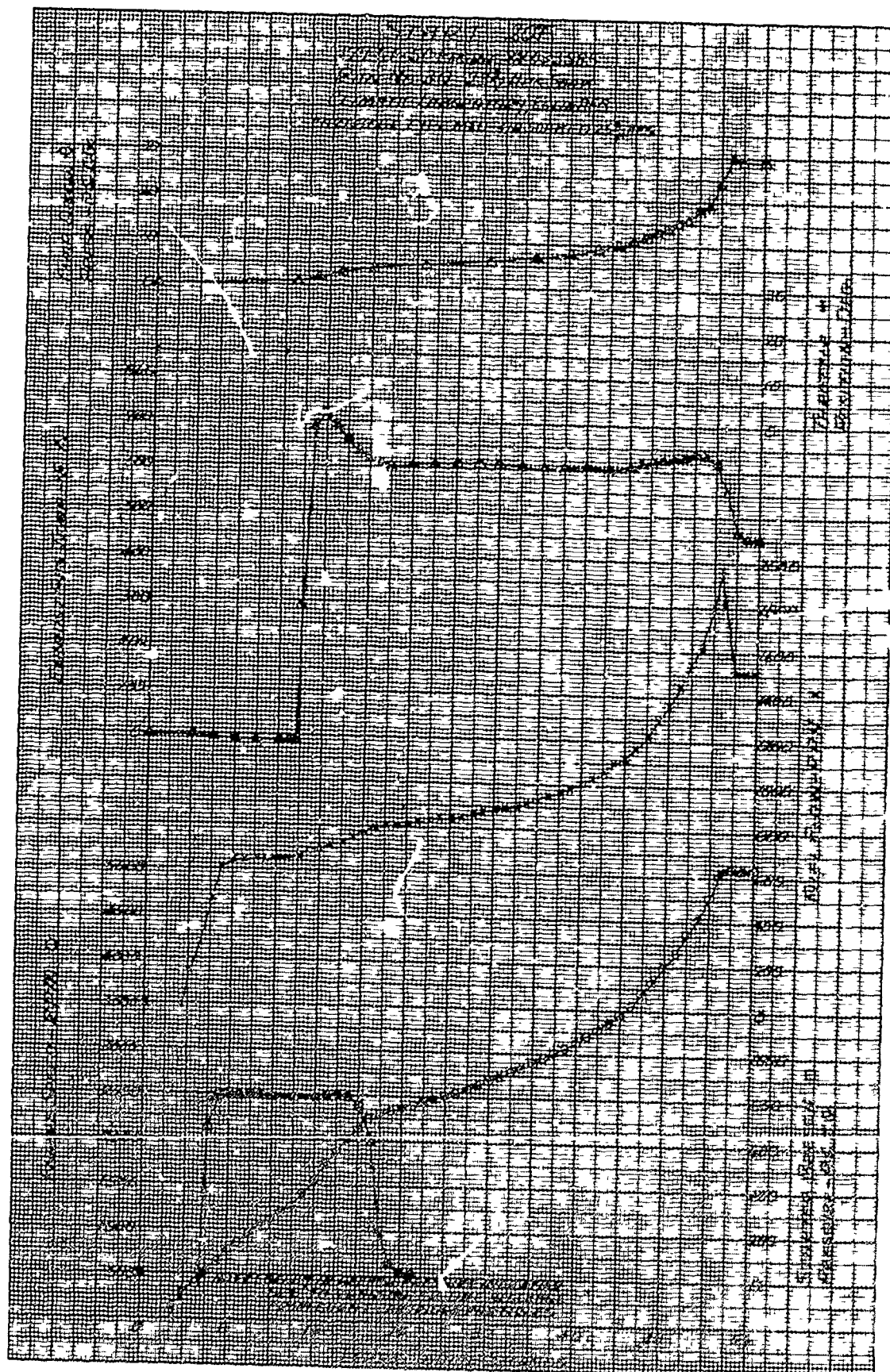


Fig. 19

F114

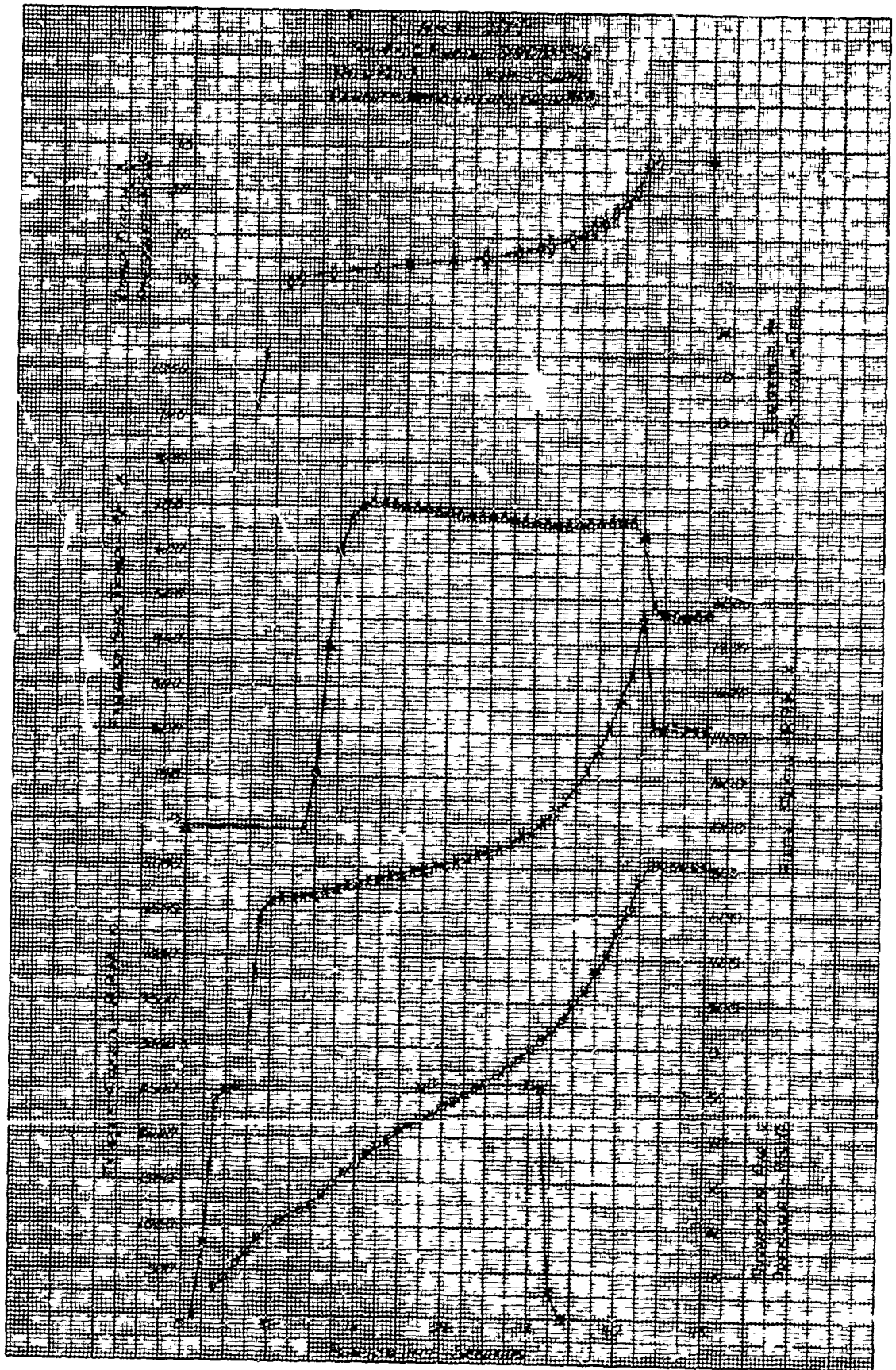


Fig. 20

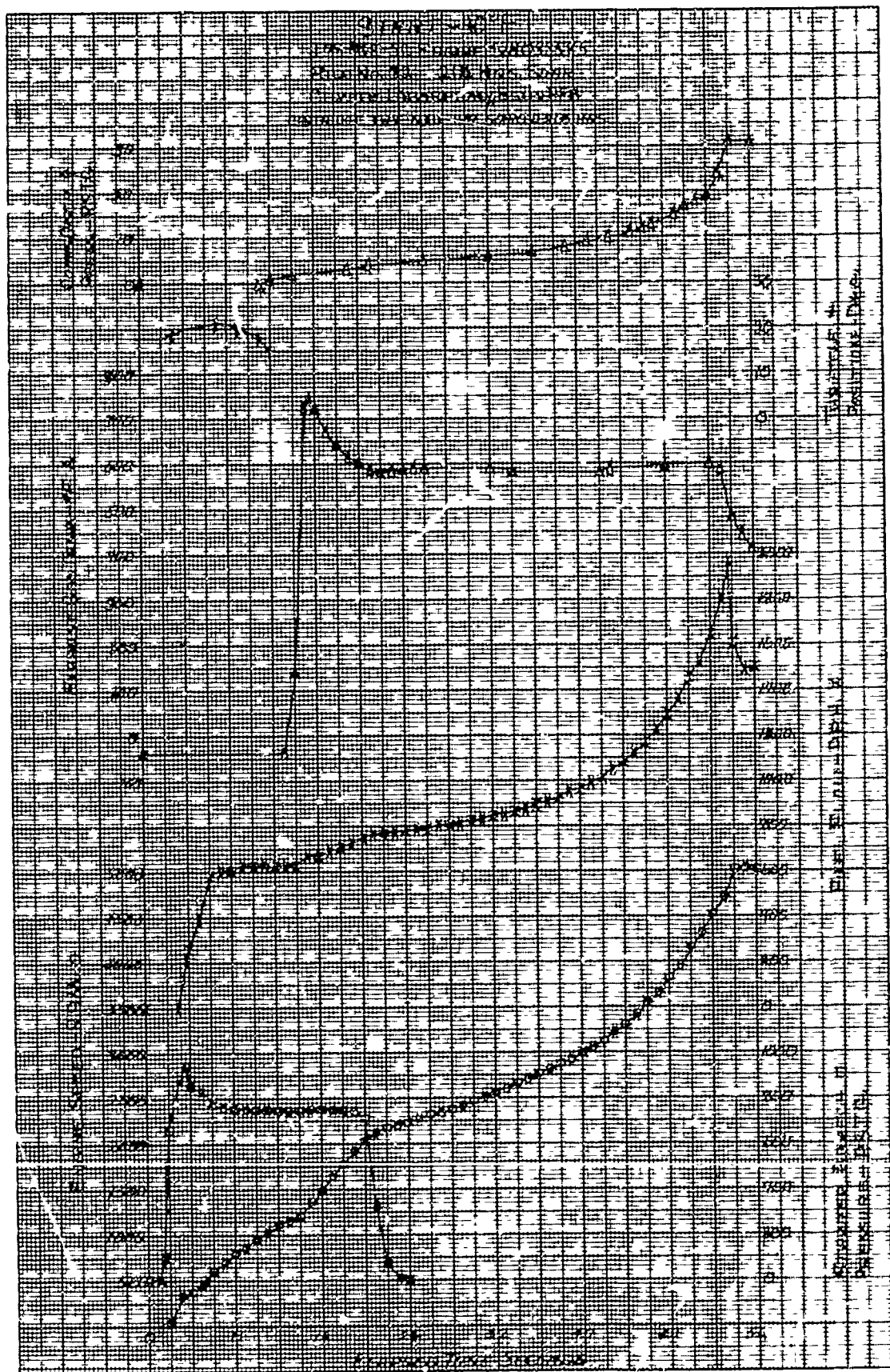


Fig. 21

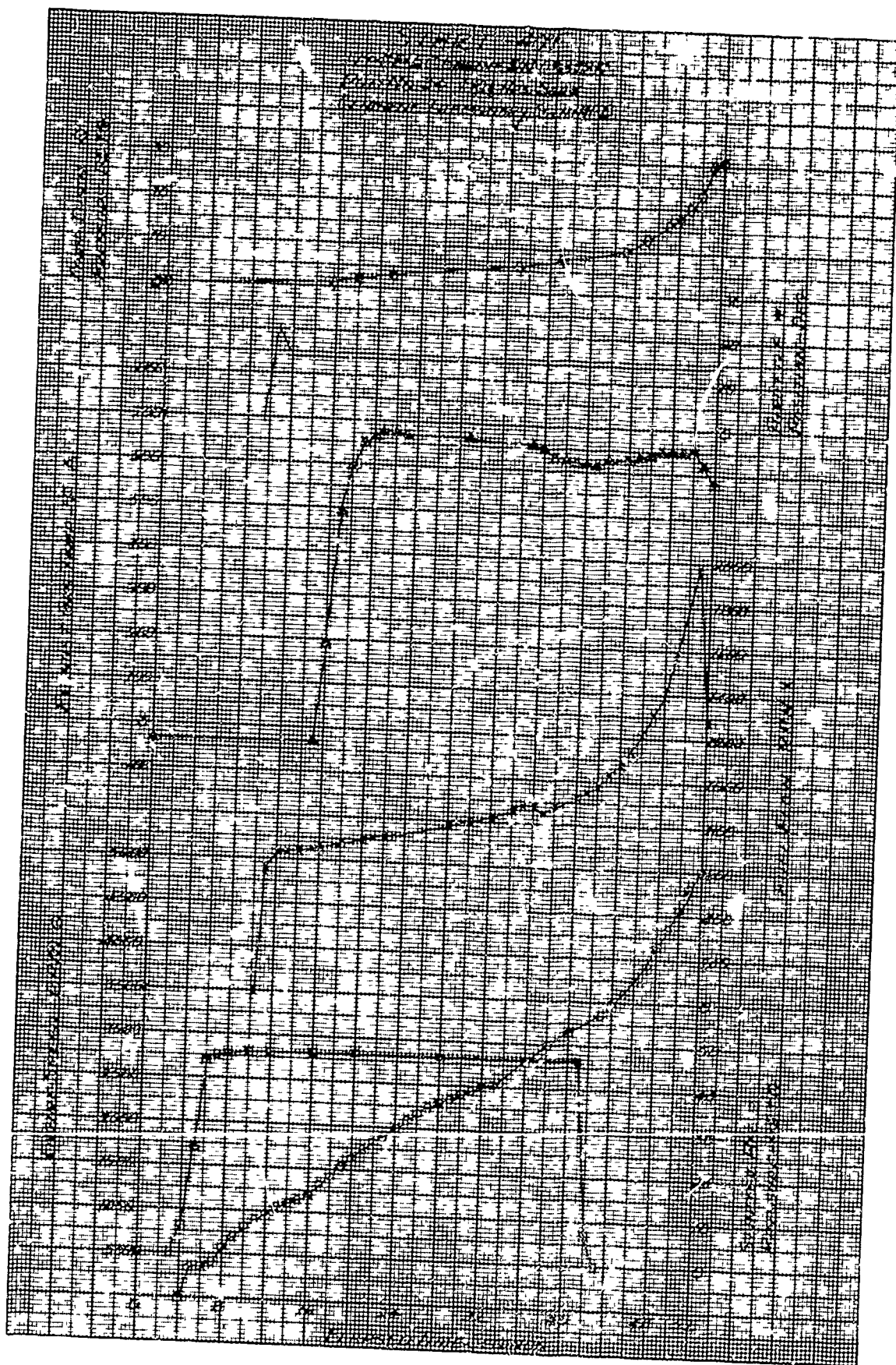


Fig. 22

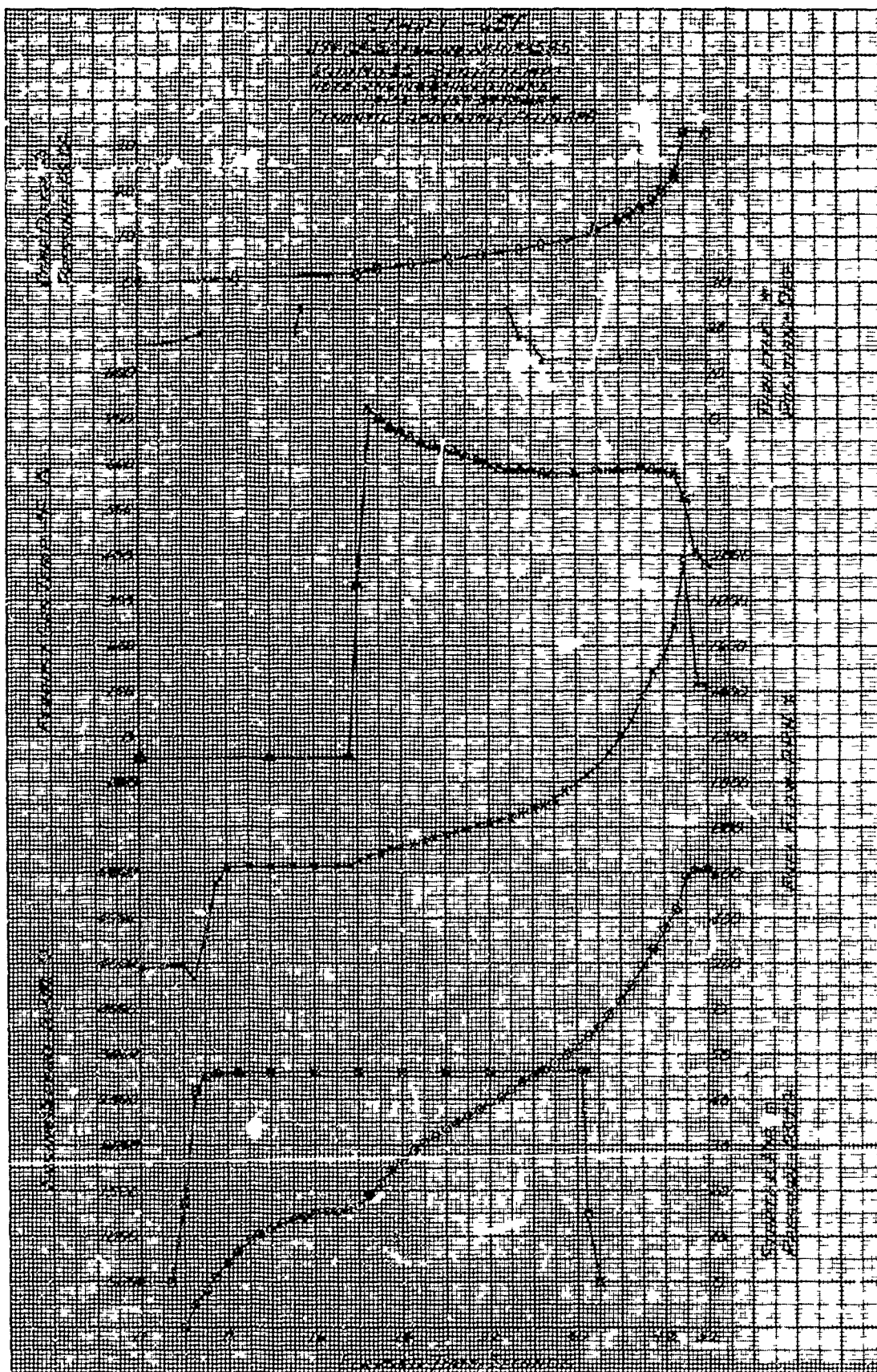
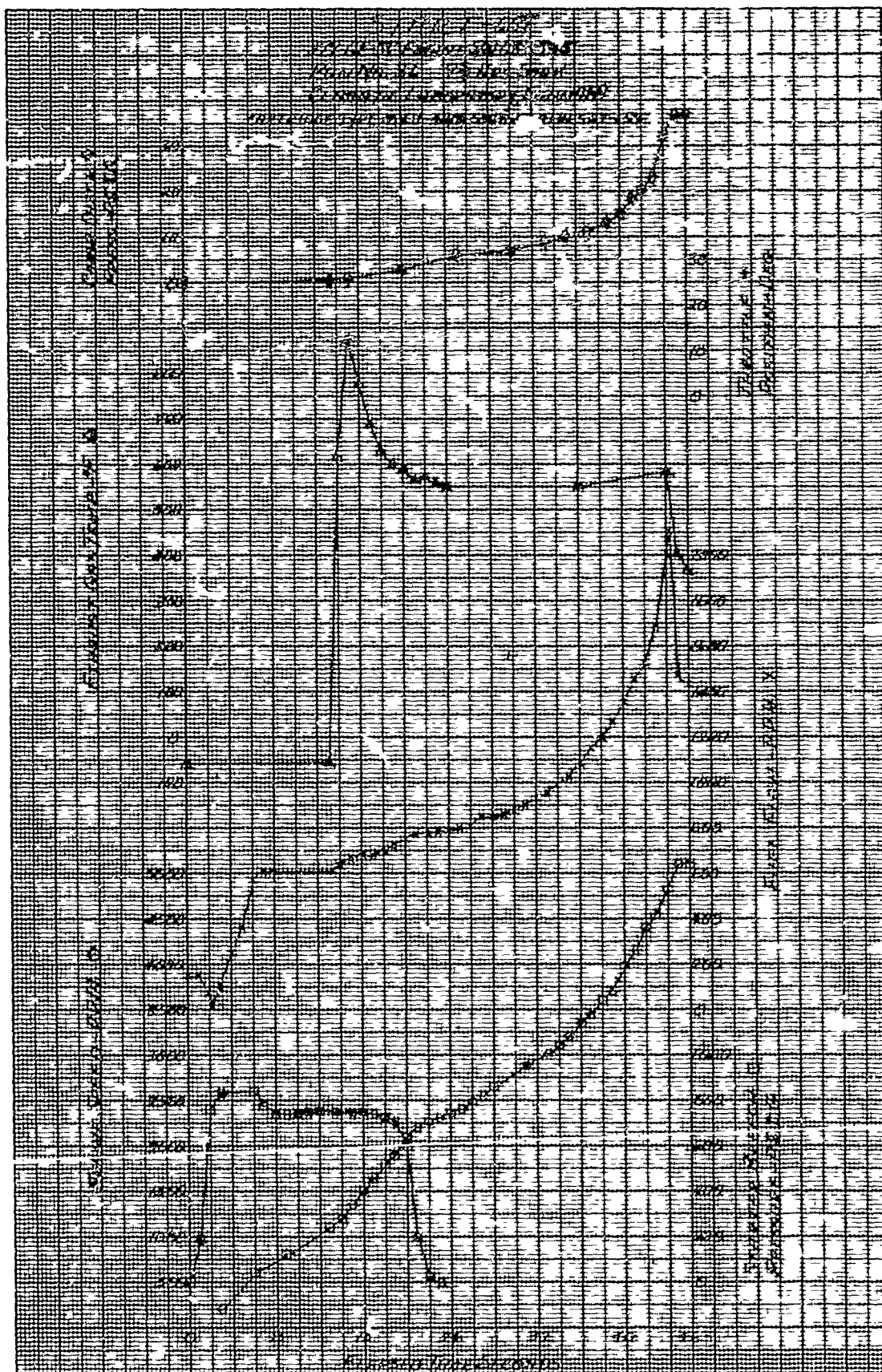


Fig. 23



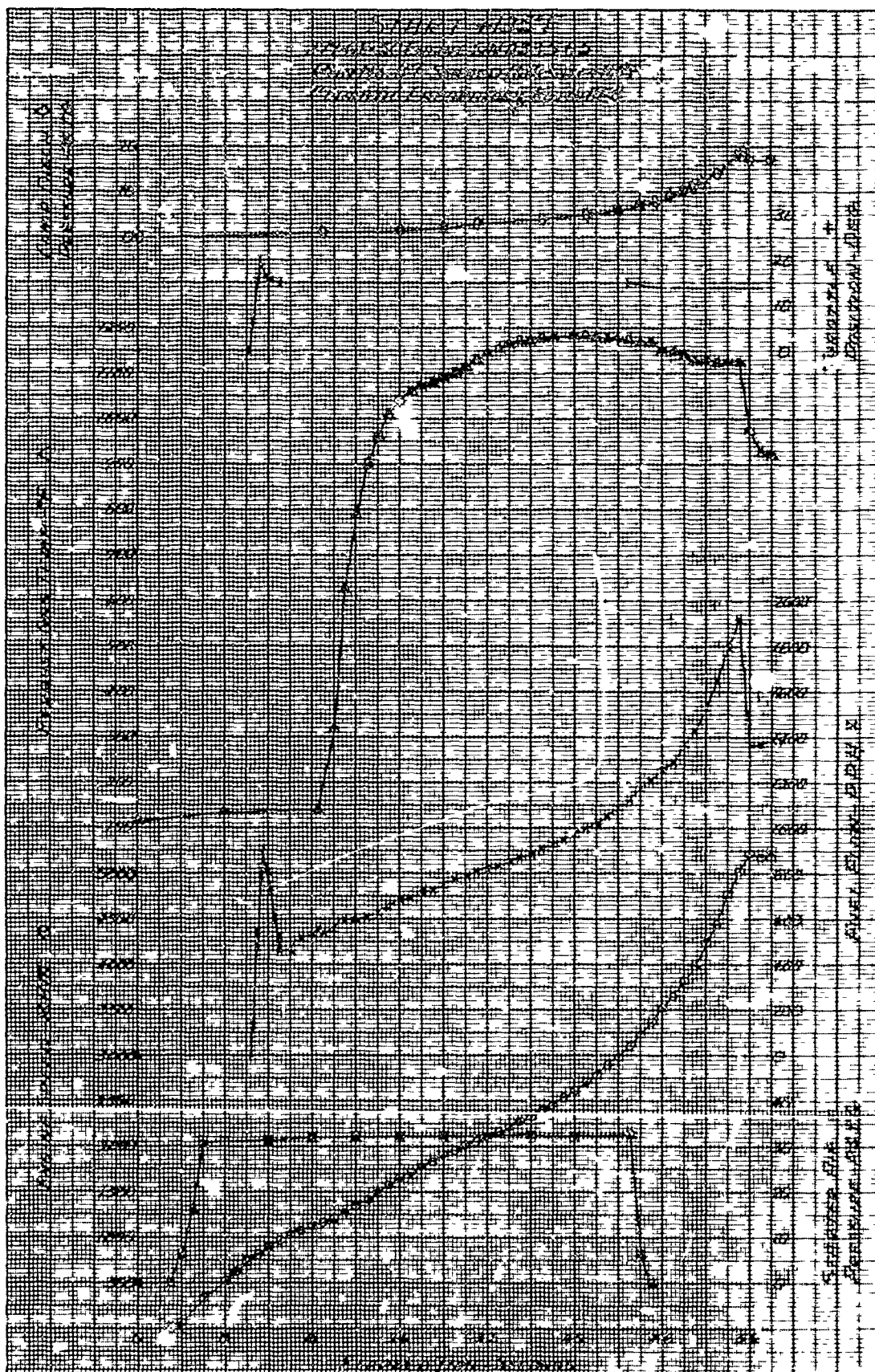


Fig. 35

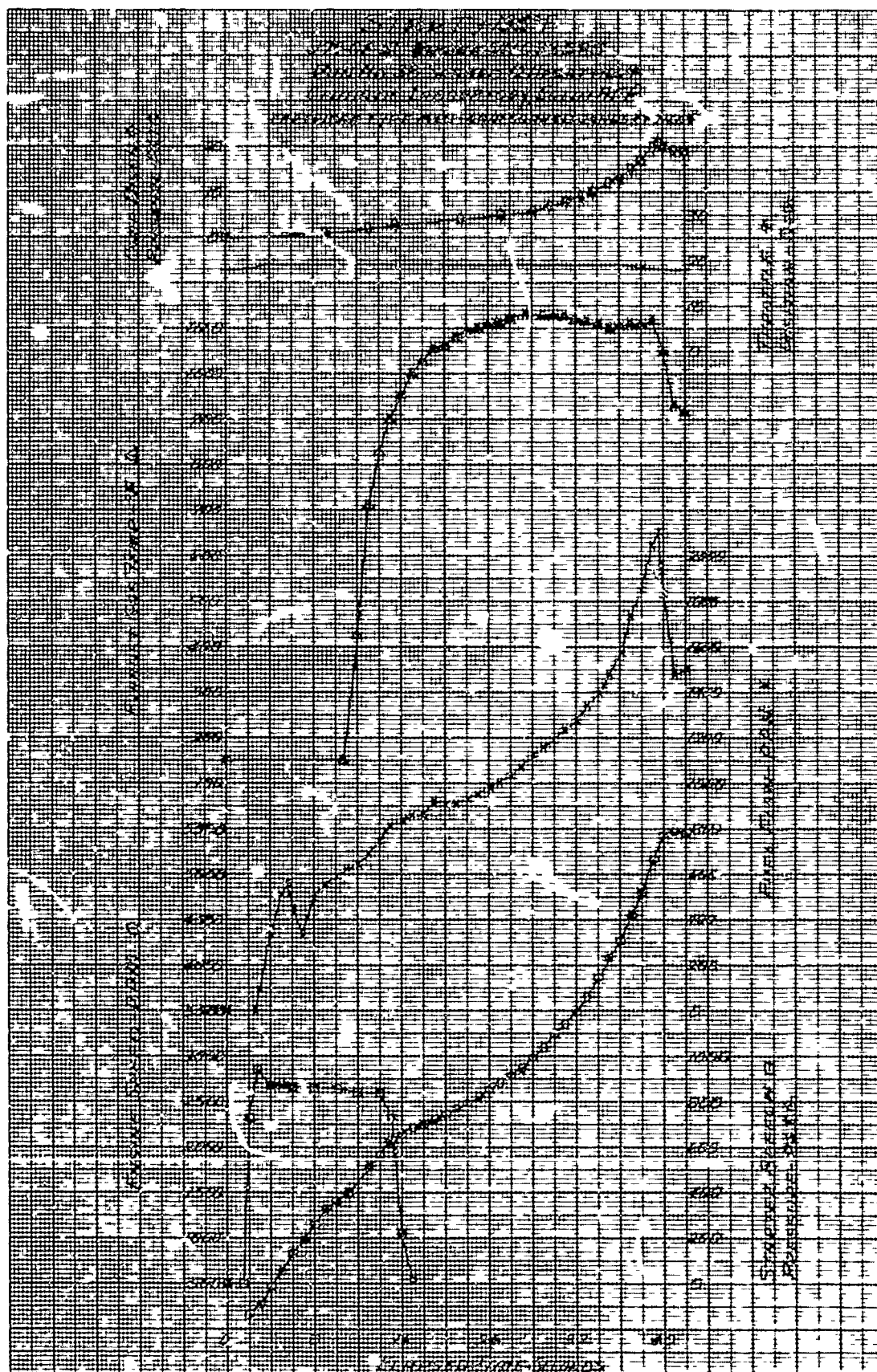


Fig. 36

Unclassified

Security Classification

**DOCUMENT CONTROL DATA - R&D**

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

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		2b. GROUP N/A	
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4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Report 17 July - 15 September 1967			
5. AUTHOR(S) (Last name, first name, initial) Goolsby, Arthur R. (PGVWT)			
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11. SUPPLEMENTARY NOTES None		12. SPONSORING MILITARY ACTIVITY OCNEPE	
13. ABSTRACT The purpose of this test was to determine the environmental starting capability of the Sundstrand Cartridge/Pneumatic Starter, Sundstrand Proposal No. 1776A-P1 (Model CPS-13) when used on the J79-GE-5C engine. A total of 38 starts were made during this test program seven at normal ambient temperatures (75°F to 80°F) six at 0°F, nine at -20°F, three at -40°F, two at -65°F, nine at +59°F and two at +135°F. The first 11 runs of the program demonstrated that the J79-GE-5C engine, using a main fuel control, P/N 404045A (unmodified) and the Sundstrand Cartridge/Pneumatic Starter, Model CPS-13, would not make satisfactory starts at -20°F or lower. Runs 12 through 26 demonstrated that the same engine and starter combination equipped with a main fuel control P/N 407070 would not make satisfactory starts at 0°F in the pneumatic mode of starting but would meet the time to idle requirement at 0°F in the cartridge mode. Runs 27 through 38 demonstrated that the J79-GE-5C engine equipped with the CPS-13 starter and a main fuel control P/N 404045A, with the recommended modifications could make satisfactory starts through out the temperature range of +135°F through -65°F.			

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
1. Hot Cold Start Test J79-GE-5C Engine						
2. J79-GE-5C Engine						
3. Starter Sundstrand, Model CPS-13						

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